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DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

WATER-SUPPLY PAPER 272

SURFACE WATER SUPPLY OF THE UNITED STATES

1909

PART XII. NORTH PACIFIC COAST

PREPARED UNDER THE DIRECTION OF M. O. LEIGHTON

BY

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SURFACE WATER SUPPLY OF THE NORTH PACIFIC COAST, 1909.

By J. C. Stevens, E. C. La Rue, and F. F. Henshaw.

INTRODUCTION.

AUTHORITY FOR INVESTIGATIONS.

This volume contains results of flow measurements made on certain streams in the United States. The work was performed by the water-resources branch of the United States Geological Survey, either independently or in cooperation with organizations mentioned herein. These investigations are authorized by the organic law of the Geological Survey (Stat. L., vol. 20, p. 394), which provides, among other things, as follows:

> Provided that this officer [the Director] shall have the direction of the Geological Survey and the classification of public lands and examination of the geological structure, mineral resources, and products of the national domain.

Inasmuch as water is the most abundant and most valuable mineral in nature, the investigation of water resources is included under the above provision for investigating mineral resources. The work has been supported since the fiscal year ending June 30, 1895, by appropriations in successive sundry civil bills passed by Congress under the following item:

> For gaging the streams and determining the water supply of the United States, and for the investigation of underground currents and artesian wells, and for the preparation of reports upon the best methods of utilizing the water resources.

The various appropriations that have been made for this purpose are as follows:

Annual appropriations for the fiscal year ending June 30—

1895	$12,500
1896	20,000
1897 to 1900, inclusive	50,000
1901 to 1902, inclusive	100,000
1903 to 1906, inclusive	200,000
1907	150,000
1908 to 1910, inclusive	100,000
1911	150,000

SCOPE OF INVESTIGATIONS.

These investigations are not complete, nor do they include all the river systems, or parts thereof, that might purposefully be studied. The scope of the work is limited by the appropriations available. The field covered is the widest and the character of the work is believed to be the best possible under the controlling conditions. The work would undoubtedly have greater scientific importance and ultimately be of more practical value if the money now expended for wide areas were concentrated on a few small drainage basins; but such a course is impossible because general appropriations made by Congress are applicable to all parts of the country. Each part demands its proportionate share of the benefits.

It is essential that records of stream flow shall be kept during a period of years long enough to determine within reasonable limits the entire range of flow from the absolute maximum to the absolute minimum. The length of such a period manifestly differs for different streams. Experience has shown that the records for some streams should cover from 5 to 10 years, and for other streams 20 years or even more, the limit being determined by the relative importance of the stream and the interdependence of the results and other long-time records on adjacent streams.

In the performance of this work an effort is made to reach the highest degree of precision possible with a rational expenditure of time and a judicious expenditure of a small amount of money. In all engineering work there is a point beyond which refinement is needless and wasteful, and this statement applies with especial force to stream-flow measurements. It is confidently believed that the stream-flow data presented in the publications of the Survey are in general sufficiently accurate for all practical purposes. Many of the records are, however, of insufficient length, owing to the unforeseen reduction of appropriations and consequent abandonment of stations. All persons are cautioned to exercise the greatest care in using such incomplete records.

Records have been obtained at more than 1,550 different points in the United States, and in addition the surface water supply of small areas in Seward Peninsula and the Yukon-Tanana region, Alaska, has been investigated. During 1909 regular gaging stations were maintained by the Survey and cooperating organizations at about 850 points in the United States, and many miscellaneous measurements were made at other points. Data were also obtained in regard to precipitation, evaporation, storage reservoirs, river profiles, and water power in many sections of the country, and will be made available in the regular surface water-supply papers and in special papers from time to time.

PURPOSES OF THE WORK.

The results contained in this volume are requisite to meet the immediate demands of many public interests, including navigation, irrigation, domestic water supply, water power, swamp and overflow land drainage, and flood prevention.

Navigation.—The Federal Government has expended more than $250,000,000 for the improvement of inland navigation, and prospective expenditures will approximate several times this amount. It is obvious that the determination of stream flow is necessary to the intelligent solution of the many problems involved.

Irrigation.—The United States is now expending $51,000,000 on Federal irrigation systems, and this amount is far exceeded by the private expenditures of this nature in the arid West. The integrity of any irrigation system depends absolutely on the amount of water available. Therefore investigations of stream flow in that portion of the country are not only of first importance in the redemption of the lands, but constitute an insurance of Federal and private investments.

Domestic water supply.—The highest use of water is for domestic supply, and although this branch of the subject is of less direct Federal interest than the branches already named, it nevertheless has so broad a significance with respect to the general welfare that the Federal Government is ultimately and intimately concerned.

Water power.—The development of the water power of the country is an economic necessity. Our stock of coal is being rapidly depleted and the cost of steam power is increasing accordingly. Industrial growth and, as a consequence, the progress of the United States as a nation will cease if cheap power is not available. Water power affords the only avenue now open. When the electric transmission of power was accomplished the relation of our water powers to national economy changed entirely. Before the day of electric transmission water power was important only at the locality at which it was generated, but it has now become a public utility in which the individual citizen is vitally interested. Inasmuch as the amount of water power that may be made available depends on the flow of rivers, the investigation of flow becomes a prerequisite in the judicious management of this source of energy.

Drainage of swamp and overflowed lands.—More than 70,000,000 acres of the richest land in this country are now practically worthless or of precarious value by reason of overflow and swamp conditions. When this land is drained it becomes exceedingly productive and its value increases many fold. Such reclamation would add to the national assets at least $700,000,000. The study of run-off is the first consideration in connection with drainage projects. If by the

drainage of a large area into any particular channel that channel becomes so gorged with water which it had not hitherto been called on to convey that overflow conditions are created in places where previously the land was not subject to inundation, then drainage results merely in an exchange of land values. This is not the purpose of drainage improvement.

Flood prevention.—The damage from floods in the United States probably exceeds on the average $100,000,000 annually, and in the year 1908, according to estimates based on reliable data, the aggregate damage approximated $250,000,000. Such an annual tax on the property of great regions should be reduced in the orderly progress of government. It goes without saying that any consideration of flood prevention must be based on a thorough knowledge of stream flow, both in the contributing areas which furnish the water and along the great lowland rivers.

PUBLICATIONS.

The data on stream flow collected by the United States Geological Survey since its inception have appeared in the annual reports, bulletins, and water-supply papers. Owing to natural processes of evolution and to changes in governmental requirements, the character of the work and the territory covered by these different publications have varied greatly. For the purpose of uniformity in the presentation of reports a general plan has been agreed upon by the United States Reclamation Service, the United States Forest Service, the United States Weather Bureau, and the United States Geological Survey, according to which the area of the United States has been divided into twelve parts whose boundaries coincide with certain natural drainage lines. The areas so described are indicated by the following list of papers on surface-water supply for 1909. The dividing line between the North Atlantic and South Atlantic drainage areas lies between York and James rivers.

Papers on surface-water supply of the United States, 1909.

Part.	No.	Title.	Part.	No.	Title.
I	261	North Atlantic coast	VI	266	Missouri River basin.
II	262	South Atlantic coast and eastern Gulf of Mexico.	VII	267	Lower Mississippi River basin.
III	263	Ohio River basin.	VIII	268	Western Gulf of Mexico.
IV	264	St. Lawrence River basin.	IX	269	Colorado River basin.
V	265	Upper Mississippi River and Hudson Bay basins.	X	270	Great Basin.
			XI	271	California.
			XII	272	North Pacific coast.

The following table gives the character of data regarding stream flow at regular stations to be found in the various publications of the United States Geological Survey, exclusive of all special papers.

Numbers of reports are inclusive and dates also are inclusive so far as the data are available.

Stream-flow data in reports of the United States Geological Survey.

[Ann.=Annual Report; B.=Bulletin; W. S.=Water-Supply Paper.]

Report.	Character of data.	Year.
10th Ann., pt. 2	Descriptive information only	
11th Ann., pt. 2	Monthly discharge	1884 to Sept., 1890.
12th Ann., pt. 2	do	1884 to June 30, 1891.
13th Ann., pt. 3	Mean discharge in second-feet	1884 to Dec. 31, 1892.
14th Ann., pt. 2	Monthly discharge (long-time records, 1871 to 1893)	1888 to Dec. 31, 1893.
B. 131	Descriptions, measurements, gage heights, and ratings	1893 and 1894.
16th Ann., pt. 2	Descriptive information only	
B. 140	Descriptions, measurements, gage heights, ratings, and monthly discharge (also many data covering earlier years).	1895.
W. S. 11	Gage heights (also gage heights for earlier years)	1896.
18th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also similar data for earlier years).	1895 and 1896.
W. S. 15	Descriptions, measurements, and gage heights, eastern United States, eastern Mississippi River, and Missouri River above junction with Kansas.	1897.
W. S. 16	Descriptions, measurements, and gage heights, western Mississippi River below junction of Missouri and Platte, and western United States.	1897.
19th Ann., pt. 4	Descriptions, measurements, ratings, and monthly discharge (also some long-time records).	1897.
W. S. 27	Measurements, ratings, and gage heights, eastern United States, eastern Mississippi River, and Missouri River.	1898.
W. S. 28	Measurements, ratings, and gage heights, Arkansas River and western United States.	1898.
20th Ann., pt. 4	Monthly discharge (also for many earlier years)	1898.
W. S. 35 to 39	Descriptions, measurements, gage heights, and ratings	1899.
21st Ann., pt. 4	Monthly discharge	1899.
W. S. 47 to 52	Descriptions, measurements, gage heights, and ratings	1900.
22d Ann., pt. 4	Monthly discharge	1900.
W. S. 65, 66	Descriptions, measurements, gage heights, and ratings	1901.
W. S. 75	Monthly discharge	1901.
W. S. 82 to 85	Complete data	1902.
W. S. 97 to 100	do	1903.
W. S. 124 to 135	do	1904.
W. S. 165 to 178	do	1905.
W. S. 201 to 214	Complete data, except descriptions	1906.
W. S. 241 to 252	Complete data	1907–8.
W. S. 261 to 272	do	1909.

NOTE.—No data regarding stream flow are given in the 15th and 17th annual reports.

The records at most of the stations discussed in these reports extend over a series of years. An index of the reports containing records prior to 1904 has been published in Water-Supply Paper 119. The first table which follows gives, by years and drainage basins, the numbers of the papers on surface-water supply published from 1899 to 1909. Wherever the data for a drainage basin appear in two papers the number of one is placed in parentheses and the portion of the basin covered by that paper is indicated in the second table. For example, in 1904 the data for Missouri River were published in Water-Supply Papers 130 and 131, and the portion of the records contained in Water-Supply Paper 131, as indicated by the second table, is that relating to Platte and Kansas rivers.

Numbers of water-supply papers containing results of stream measurements, 1899–1909.

	1899 [a]	1900 [b]	1901	1902	1903	1904	1905	1906	1907–8	1909
Atlantic coast and eastern Gulf of Mexico:										
New England rivers	35	47	65, 75	82	97	124	165	201	241	261
Hudson River to Delaware River, inclusive	35	47, (48)	65, 75	82	97	125	166	202	241	261
Susquehanna River to York River, inclusive	35	48	65, 75	82	97	126	167	203	241	261
James River to Yadkin River, inclusive	(35), 36	48	65, 75	(82), 83	(97), 98	126	167	203	242	262
Santee River to Pearl River, inclusive	36	48	65, 75	83	98	127	168	204	242	262
St. Lawrence River	36	49	65, 75	(82), 83	97	129	170	206	244	264
Hudson Bay	.....	.....	66, 75	85	100	130	171	207	245	265
Mississippi River:										
Ohio River	36	48, (49)	65, 75	83	98	128	169	205	243	263
Upper Mississippi River	36	49	65, 75	83	98, (99)	128, (130)	171	207	245	265
Missouri River	(36), 37	49, (50)	66, 75	84	99	130, (131)	172	208	246	266
Lower Mississippi River	37	50	(65), 66, 75	(83), 84	(98), 99	(128), 131	(169), 173	(205), 209	247	267
Western Gulf of Mexico	37	50	66, 75	84	99	132	174	210	248	268
Pacific coast and Great Basin:										
Colorado River	(37), 38	51	66, 75	85	100	133, (134)	175, (177)	211, (213)	249, (251)	269, (271)
Great Basin	38, (39)	50	66, 75	85	100	133, (134)	176, (177)	212, (213)	250, (251)	270, (271)
South Pacific coast to Klamath River, inclusive	(38), 39	51	66, 75	85	100	134	177	213	251	271
North Pacific coast	38	51	66, 75	85	100	135	(177), 178	214	252	272

[a] Rating tables and index to Water-Supply Papers 35–39 contained in Water-Supply Paper 39.
[b] Rating tables and index to Water-Supply Papers 47–52 and data on precipitation, wells, and irrigation in California and Utah contained in Water-Supply Paper 52.

Numbers of water-supply papers containing data covering portions of drainage basins.

No.	River basin.	Tributaries included.
35	James	
36	Missouri	Gallatin.
37	Colorado	Green, Gunnison, Grand above junction with Gunnison.
38	Sacramento	Except Kings and Kern.
39	Great Basin	Mohave.
48	Delaware	Wissahickon and Schuylkill.
49	Ohio	Scioto.
50	Missouri	Loup and Platte near Columbus, Nebr. All tributaries below junction with Platte.
65	Lower Mississippi	Yazoo.
82	James	
	St. Lawrence	Lake Ontario, tributaries to St. Lawrence River proper.
83	Lower Mississippi	Yazoo.
97	James	
98	Lower Mississippi	Do.
99	Upper Mississippi	Tributaries from the west.
128	Lower Mississippi	Yazoo.
130	Upper Mississippi	Tributaries from the west.
131	Missouri	Platte, Kansas.
134	Colorado	Data near Yuma, Ariz., repeated.
	Great Basin	Susan, Owens, Mohave.
169	Lower Mississippi	Yazoo.
177	Colorado	Below junction with Gila.
	Great Basin	Susan repeated, Owens, Mohave.
	North Pacific coast	Rogue, Umpqua, Siletz.
205	Lower Mississippi	Yazoo, Homochitto.
213	Colorado	Data at Hardyville repeated; at Yuma, Salton Sea.
	Great Basin	Owens, Mohave.
251	Colorado	Yuma and Salton Sea stations repeated.
271	Great Basin	Owens River basin.

The order of treatment of stations in any basin in these papers is downstream. The main stem of any river is determined on the basis of drainage area, local changes in name and lake surface being disregarded. After all stations from the source to the mouth of the main stem of the river have been given, the tributaries are taken up in regular order from source to mouth. The tributaries are treated the same as the main stream, all stations in each tributary basin being given before taking up the next one below.

The exceptions to this rule occur in the records for Mississippi River, which are given in four parts, as indicated above, and in the records for large lakes, where it is often clearer to take up the streams in regular order around the rim of the lake than to cross back and forth over the lake surface.

DEFINITION OF TERMS.

The volume of water flowing in a stream—the "run-off" or "discharge"—is expressed in various terms, each of which has become associated with a certain class of work. These terms may be divided into two groups: (1) Those which represent a rate of flow, as second-feet, gallons per minute, miner's inches, and run-off in second-feet per square mile, and (2) those which represent the actual quantity of water, as run-off in depth in inches and acre-feet. They may be defined as follows:

"Second-foot" is an abbreviation for cubic foot per second and is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a rate of 1 foot per second. It is generally used as a fundamental unit from which otners are computed by the use of the factors given in the following table of equivalents.

"Gallons per minute" is generally used in connection with pumping and city water supply.

The "miner's inch" is the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally. It is commonly used by miners and irrigators throughout the West and is defined by statute in each State in which it is used.

"Second-feet per square mile" is the average number of cubic feet of water flowing per second from each square mile of area drained, on the assumption that the run-off is distributed uniformly both as regards time and area.

"Run-off, depth in inches on drainage area," is the depth to which the drainage area would be covered if all the water flowing from it in a given period were conserved and uniformly distributed on the surface. It is used for comparing run-off with rainfall, which is usually expressed in depth in inches.

"Acre-foot" is equivalent to 43,560 cubic feet, and is the quantity required to cover an acre to the depth of 1 foot. It is commonly used in connection with storage for irrigation work.

CONVENIENT EQUIVALENTS.

The following is a list of convenient equivalents for use in hydraulic computations:

1 second-foot equals 40 California miner's inches (law of March 23, 1901).
1 second-foot equals 38.4 Colorado miner's inches.
1 second-foot equals 40 Arizona miner's inches.
1 second-foot equals 7.48 United States gallons per second; equals 448.8 gallons per minute; equals 646,272 gallons for one day.
1 second-foot equals 6.23 British imperial gallons per second.
1 second-foot for one year covers 1 square mile 1.131 feet or 13.572 inches deep.
1 second-foot for one year equals 31,536,000 cubic feet.
1 second-foot equals about 1 acre-inch per hour.
1 second-foot for one day covers 1 square mile 0.03719 inch deep.
1 second-foot for one 28-day month covers 1 square mile 1.041 inches deep.
1 second-foot for one 29-day month covers 1 square mile 1.079 inches deep.
1 second-foot for one 30-day month covers 1 square mile 1.116 inches deep.
1 second-foot for one 31-day month covers 1 square mile 1.153 inches deep.
1 second-foot for one day equals 1.983 acre-feet.
1 second-foot for one 28-day month equals 55.54 acre-feet.
1 second-foot for one 29-day month equals 57.52 acre-feet.
1 second-foot for one 30-day month equals 59.50 acre-feet.
1 second-foot for one 31-day month equals 61.49 acre-feet.
100 California miner's inches equals 18.7 United States gallons per second.
100 California miner's inches equals 96.0 Colorado miner's inches.
100 California miner's inches for one day equals 4.96 acre-feet.
100 Colorado miner's inches equals 2.60 second-feet.
100 Colorado miner's inches equals 19.5 United States gallons per second.
100 Colorado miner's inches equals 104 California miner's inches.
100 Colorado miner's inches for one day equals 5.17 acre-feet.
100 United States gallons per minute equals 0.223 second-foot.
100 United States gallons per minute for one day equals 0.442 acre-foot.
1,000,000 United States gallons per day equals 1.55 second-feet.
1,000,000 United States gallons equals 3.07 acre-feet.
1,000,000 cubic feet equals 22.95 acre-feet.
1 acre-foot equals 325,850 gallons.
1 inch deep on 1 square mile equals 2,323,200 cubic feet.
1 inch deep on 1 square mile equals 0.0737 second-foot per year.
1 foot equals 0.3048 meter.
1 mile equals 1.60935 kilometers.
1 mile equals 5,280 feet.
1 acre equals 0.4047 hectare.
1 acre equals 43,560 square feet.
1 acre equals 209 feet square, nearly.
1 square mile equals 2.59 square kilometers.
1 cubic foot equals 0.0283 cubic meter.
1 cubic foot equals 7.48 gallons.
1 cubic foot of water weighs 62.5 pounds.
1 cubic meter per minute equals 0.5886 second-foot.

1 horsepower equals 550 foot-pounds per second.
1 horsepower equals 76.0 kilogram-meters per second.
1 horsepower equals 746 watts.
1 horsepower equals 1 second-foot falling 8.80 feet.
$1\frac{1}{3}$ horsepower equal about 1 kilowatt.

To calculate water power quickly: $\frac{\text{Sec.-ft.} \times \text{fall in feet}}{11}$ = net horsepower on water wheel realizing 80 per cent of theoretical power.

EXPLANATION OF TABLES.

For each drainage basin there is given a brief description of general conditions covering such features as area, source, tributaries, topography, geology, conditions of forestation, rainfall, ice conditions, irrigation, storage, power possibilities, and other special features of importance or interest.

For each regular current-meter gaging station are given in general, and so far as available, the following data: Description of station, list of discharge measurements, table of daily gage heights, table of daily discharges, table of monthly and yearly discharges and run-off. For stations located at weirs or dams the gage-height table is omitted.

In addition to statements regarding the location and installation of current-meter stations the descriptions give information in regard to any conditions which may affect the constancy of the relation of gage height to discharge, covering such points as ice, logging, shifting conditions of flow, and backwater; also information regarding diversions which decrease the total flow at the measuring section. Statements are also made regarding the accuracy and reliabilty of the data.

The discharge-measurement table gives the results of the discharge measurements made during the year, including the date, name of hydrographer, width and area of cross section, gage height, and discharge in second-feet.

The table of daily gage heights gives the daily fluctuations of the surface of the river as found from the mean of the gage readings taken each day. At most stations the gage is read in the morning and in the evening. The gage height given in the table represents the elevation of the surface of the water above the zero of the gage. All gage heights during ice conditions, backwater from obstructions, etc., are published as recorded, with suitable footnotes. The rating is not applicable for such periods unless the proper corrections to the gage heights are known and applied. Attention is called to the fact that the zero of the gage is placed at an arbitrary datum and has no relation to zero flow or the bottom of the river. In general, the zero is located somewhat below the lowest known flow, so that negative readings shall not occur.

The discharge measurements and gage heights are the base data from which rating tables, daily-discharge tables, and monthly-discharge tables are computed.

The rating table gives, either directly or by interpolation, the discharge in second-feet corresponding to every stage of the river recorded during the period for which it is applicable. It is not published in this report but can be determined from the daily gage heights and daily discharges for the purpose of verifying the published results as follows:

First plot the discharge measurements for the current and earlier years on cross-section paper with gage heights in feet as ordinates and discharge in second-feet as abscissas. Then tabulate a number of gage heights taken from the daily gage-height table for the complete range of stage given and the corresponding discharges for the days selected from the daily-discharge table and plot the values on the cross-section paper. The last points plotted will define the rating curve used and will lie among the plotted discharge measurements. After drawing the rating curve, a table can be developed by scaling off the discharge in second-feet for each tenth foot of gage height. These values should be so adjusted that the first differences shall always be increasing or constant, except for known back-water conditions.

The table of daily discharges gives the discharges in second-feet as determined from the rating tables corresponding to the observed gage heights.

In the table of monthly discharge the column headed "Maximum" gives the mean flow, as determined from the rating table, for the day when the mean gage height was highest. As the gage height is the mean for the day, it does not indicate correctly the stage when the water surface was at crest height and the corresponding discharge consequently larger than given in the maximum column. Likewise, in the column of "Minimum" the quantity given is the mean flow for the day when the mean gage height was lowest. The column headed "Mean" is the average flow in cubic feet for each second during the month. On this the computations for the remaining columns, which are defined on page 17, are based.

FIELD METHODS OF MEASURING STREAM FLOW.

There are three distinct methods of determining the flow of open-channel streams: (1) By measurements of slope and cross section and the use of Chezy's and Kutter's formula; (2) by means of a weir or dam; (3) by measurements of the velocity of the current and of the area of the cross section. The method chosen depends on the local physical conditions, the degree of accuracy desired, the funds available, and the length of time that the record is to be continued.

Slope method.—Much information has been collected relative to the coefficients to be used in the Chezy formula, $v=c\sqrt{Rs}$. This has been utilized by Kutter, both in developing his formula for c and in determining the values of the coefficient n which appears therein. The results obtained by the slope method are in general only roughly approximate, owing to the difficulty in obtaining accurate data and the uncertainty of the value for n to be used in Kutter's formula. The most common use of this method is in estimating the flood discharge of a stream when the only data available are the cross section, the slope as shown by marks along the bank, and a knowledge of the general conditions. It is seldom used by the United States Geological Survey. For full information regarding this method the reader is referred to the various textbooks on hydraulics.

Weir method.—Relatively few stations are maintained at weirs or dams by the United States Geological Survey. Standard types of sharp-crested and broad-crested weirs within the limits for which accurate coefficients have been experimentally obtained give very accurate records of discharge if properly maintained. At practically all broad-crested weirs, however, there is a diversion of water either through or around the dam, usually for the purpose of development of water power. The flow is often complicated, and the records are subject to errors from such sources as leakage through the dam, backwater at high stages, uncertainty regarding coefficient, irregularity of crest, obstructions from logs or ice, use of flashboards, old turbines with imperfect ratings, and many others depending on the type of development and the uses of the diverted water.

In general, records of discharge at dam are usually accurate enough for practical use if no others are available. It has been the general experience of the United States Geological Survey, however, that records at current-meter gaging stations under unobstructed channel conditions are more accurate than those collected at dams, and where the conditions are reasonably favorable are practically as good as those obtained at sharp-crested weirs.[1]

Velocity method.—Streams in general present throughout their courses, to a greater or less extent, all conditions of permanent, semi-permanent, and varying conditions of flow. In accordance with the location of the measuring section with respect to these physical conditions, current-meter gaging stations may in general be divided into four classes—(1) those with permanent conditions of flow; (2) those with beds which change only during extreme high water;

[1] The determination of discharge over the different types of weirs and dams is treated fully in "Weir experiments, coefficients, and formulas" (Water-Supply Paper 200) and in the various textbooks on hydraulics. "Turbine water-wheel tests and power tables" (Water-Supply Paper 180) treats of the discharge through turbines when used as meters. The edition of the latter paper is nearly exhausted. It can, however, be consulted at most of the larger libraries of the country, or can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 20 cents.

(3) those with beds which change frequently but which do not cause a variation of more than about 5 per cent of the discharge curves from year to year; and (4) those with constantly shifting beds. In determining the daily flow different office methods are necessary for each class. The field data on which the determinations are based and the methods of collecting them are, however, in general the same.

Great care is taken in the selection and equipment of gaging stations for determining discharge by velocity measurements, in order that the data may have the required degree of accuracy. They are located, as far as possible, at such points that the relation between gage height and discharge will always remain constant for any given stage. The experience of engineers of the Geological Survey has been that permanency of conditions of flow is the prime requisite of any current-meter gaging station when maintained for several years unless funds are available to cover all changes in conditions of flow. A straight, smooth section without cross currents, backwater, boils, etc., at any stage is highly desirable, but on most streams is not attainable except at the cost of a cable equipment. Rough, permanent sections, if measurements are properly made by experienced engineers, taking measuring points at a distance apart of 2 to 5 per cent or less of the total width, will within reasonable limits yield better results for a given outlay of money than semi-permanent or shifting sections with smooth, uniform current. So far as possible stations are located where the banks are high and not subject to overflow at high stages and out of the influence of tributary streams, dams, or other artificial obstructions which might affect the relation between gage height and discharge.

A gaging station consists essentially of a gage for determining the daily fluctuations of stage of the river and some structure or apparatus from which discharge measurements are made—usually a bridge or cable.

The two factors required to determine the discharge of a stream past a section perpendicular to the mean direction of the current are the area of the cross section and the mean velocity of flow normal to that section.

In making a measurement with a current meter a number of points, called measuring points, are measured off above and in the plane of the measuring section at which observations of depth and velocity are taken. (See Pl. I, *A*.) These points are spaced equally for those parts of the section where the flow is uniform and smooth and are spaced unequally for other parts, according to the discretion and judgment of the engineer. In general the points should not be spaced farther apart than 5 per cent of the distance between piers, nor farther apart than the approximate mean depth of the section at the time of measurement.

A. FOR BRIDGE MEASUREMENT.

B. FOR WADING MEASUREMENT.

TYPICAL GAGING STATIONS.

The measuring points divide the total cross section into elementary strips at each end of which observations of depth and velocity are made. The discharge of any elementary strip is the product of the average of the depths at the two ends times the width of the strip times the average of the mean velocities at the two ends of the strip. The sum of the discharges of the elementary strips is the total discharge of the stream.[1]

Depths for the determination of the area are usually obtained by sounding with the current meter and cable. In rough sections or swift current an ordinary weight and cable are used, particular care being taken that all observations shall be in the plane of the cross section.

Two methods of determining the velocity of flow of a stream are in general use—the float method and the current-meter method.

The float method, with its various modifications of surface, subsurface, and tube or rod floats, is now considered obsolete in the ordinary practice of the United States Geological Survey. The use of this method is limited to special conditions where it is impracticable to use the current meter, such as in places where large quantities of ice or débris which may damage the meter are flowing with the current, and for miscellaneous measurements or other work where a high degree of accuracy is not necessary. Tube floats are very satisfactory for use in canals with regular bottoms and even flow of current. Measurements by the float method are made as follows: The velocity of flow of the stream is obtained by observing the time which it takes floats set free at different points across the stream to pass between two range lines about 200 feet apart. The area used is the mean value obtained from several cross sections measured between the two range lines. The chief disadvantages of this method are difficulty in obtaining the correct value of mean area for the course used and uncertainty regarding the proper coefficient to apply to the observed velocity.[2]

The Price current meter is now used almost to the exclusion of other types of meters by the United States Geological Survey in the determination of the velocity of flow of water in open channels, a use for which it is adapted under practically all conditions.[3] Plate II shows in the center the new type of penta-recording current meter equipped for measurements at bridge and cable stations; on the left the same type of meter is shown equipped for wading measurements

[1] For a discussion of methods of computing the discharge of a stream see Engineering News, June 25, 1908.

[2] Further information regarding this method is given in Water-Supply Paper 95 and in the various textbooks covering the general subject of stream flow. The edition of this paper is nearly exhausted. It can, however, be consulted at most of the larger libraries of the country, or can be obtained from the Superintendent of Documents, Washington, D. C., at a cost of 15 cents.

[3] See Hoyt, J. C., and others, Use and care of the current meter as practiced by the U. S. Geological Survey: Trans. Am. Soc. C. E., vol. 66, 1910, p. 70.

to record by the acoustic method; on the right the meter is shown equipped to record electrically. (See Pl. I, *B*.) Briefly, the meter consists of six cups attached to a vertical shaft which revolves on a conical hardened-steel point when immersed in moving water. The revolutions are indicated electrically. The rating, or the relation between the velocity of the moving water and the revolutions of the wheel, is determined for each meter by drawing it through still water for a given distance at different speeds and noting the number of revolutions for each run. From the data thus obtained a rating table is prepared which gives the velocity per second of moving water for any number of revolutions in a given time interval. The ratio of revolutions per second to velocity of flow in feet per second is very nearly a constant for all speeds and is approximately 0.45.

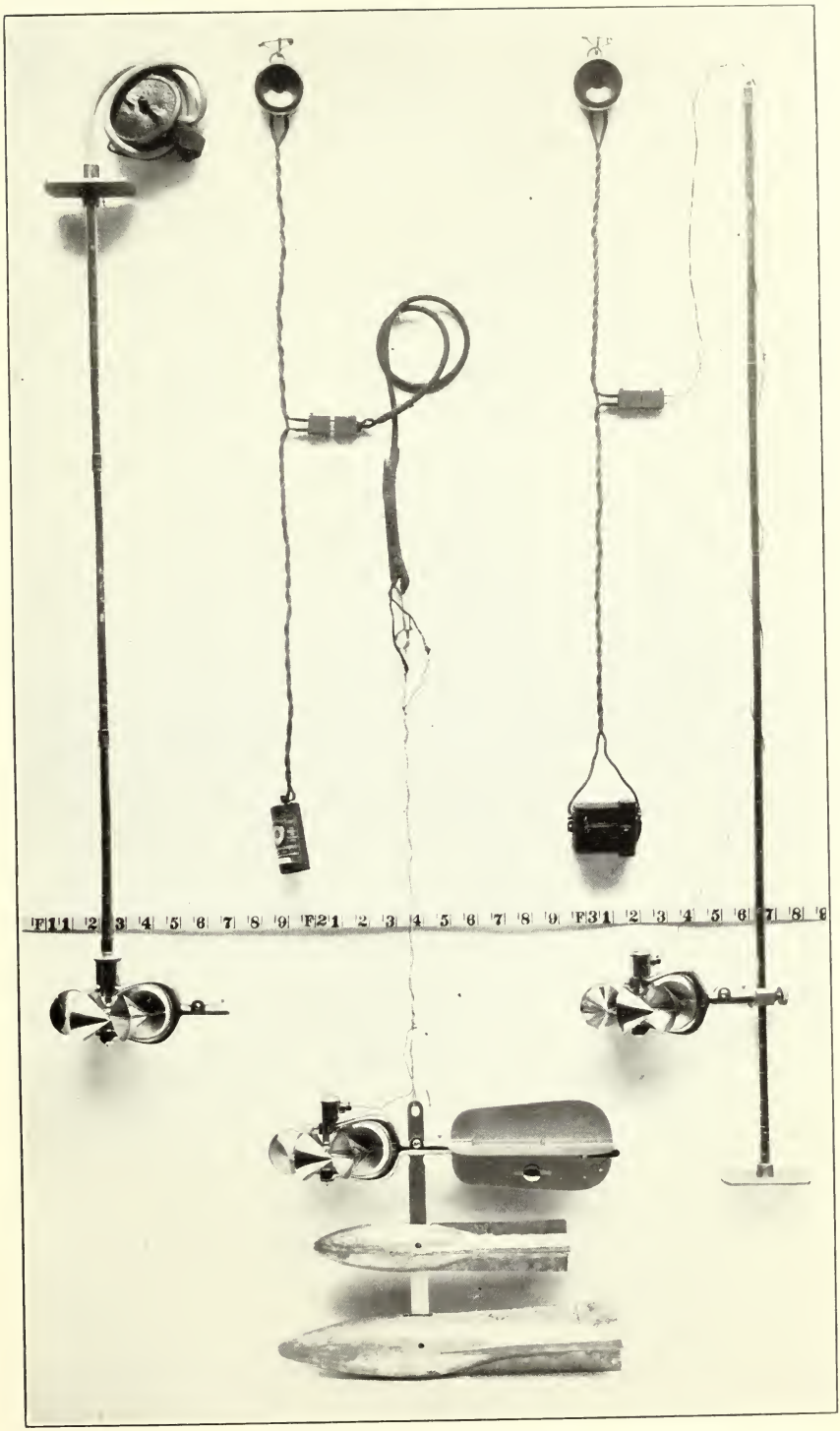
Three classes of methods of measuring velocity with current meters are in general use—multiple-point, single-point, and integration.

The two principal multiple-point methods in general use are the vertical velocity curve and 0.2 and 0.8 depth.

In the vertical velocity curve method a series of velocity determinations are made in each vertical at regular intervals, usually about 10 to 20 per cent of the depth apart. By plotting these velocities as abscissas and their depths as ordinates and drawing a smooth curve among the resulting points, the vertical velocity curve is developed. This curve shows graphically the magnitude and changes in velocity from the surface to the bottom of the stream. The mean velocity in the vertical is then obtained by dividing the area bounded by this velocity curve and its axis by the depth. This method of obtaining the mean velocity in the vertical is probably the best known, but on account of the length of time required to make a complete measurement its use is largely limited to the determination of coefficients for purposes of comparison and to measurements under ice.

In the second multiple-point method the meter is held successively at 0.2 and 0.8 depth, and the mean of the velocities at these two points is taken as the mean velocity for that vertical. (See Pl. I, *A*.) On the assumption that the vertical velocity curve is a common parabola with horizontal axis, the mean of the velocities at 0.22 and 0.79 depth will give (closely) the mean velocity in the vertical. Actual observations under a wide range of conditions show that this multiple-point method gives the mean velocity very closely for open-water conditions and that in a completed measurement it seldom varies as much as 1 per cent from the value given by the vertical velocity curve method. Moreover, the indications are that it holds nearly as well for ice-covered rivers. It is very extensively used in the regular practice of the United States Geological Survey.

The single-point method consists in holding the meter either at the depth of the thread of mean velocity or at an arbitrary depth



SMALL PRICE CURRENT METERS.

for which the coefficient for reducing to mean velocity has been determined or must be assumed.

Extensive experiments by means of vertical velocity curves show that the thread of mean velocity generally occurs between 0.5 and 0.7 total depth. In general practice the thread of mean velocity is considered to be at 0.6 depth, and at this point the meter is held in most of the measurements made by the single-point method. A large number of vertical velocity curve measurements, taken on many streams and under varying conditions, show that the average coefficient for reducing the velocity obtained at 0.6 depth to mean velocity is practically unity. The variation of the coefficient from unity in individual cases is, however, greater than in the 0.2 and 0.8 method and the general results are not as satisfactory.

In the other principal single-point method the meter is held near the surface, usually 1 foot below, or low enough to be out of the effect of the wind or other disturbing influences. This is known as the subsurface method. The coefficient for reducing the velocity taken at the subsurface to the mean has been found to be in general from about 0.85 to 0.95, depending on the stage, velocity, and channel conditions. The higher the stage the larger the coefficient. This method is especially adapted for flood measurements, or when the velocity is so great that the meter can not be kept in the correct position for the other methods.

The vertical integration method consists in moving the meter at a slow, uniform speed from the surface to the bottom and back again to the surface and noting the number of revolutions and the time taken in the operation. This method has the advantage that the velocity at each point of the vertical is measured twice. It is useful as a check on the point methods. In using the Price meter great care should be taken that the vertical movement of the meter is not rapid enough to vitiate the accuracy of the resulting velocity.

The determination of the flow of an ice-covered stream is difficult, owing to diversity and instability of conditions during the winter period and also to lack of definite information in regard to the laws of flow of water under ice. The method now employed is to make frequent discharge measurements during the frozen periods by the 0.2 and 0.8 and the vertical velocity curve methods, and to keep an accurate record of the conditions, such as the gage height to the surface of the water as it rises in a hole cut in the ice, and the thickness and character of the ice. From these data an approximate estimate of the daily flow can be made by constructing a rating curve (really a series of curves) similar to that used for open channels, but considering, in addition to gage heights and discharge, the varying thickness of ice.[1]

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[1] For information in regard to flow under ice cover, see Water Supply Paper 187.

OFFICE METHODS OF COMPUTING AND STUDYING DISCHARGE AND RUN-OFF.

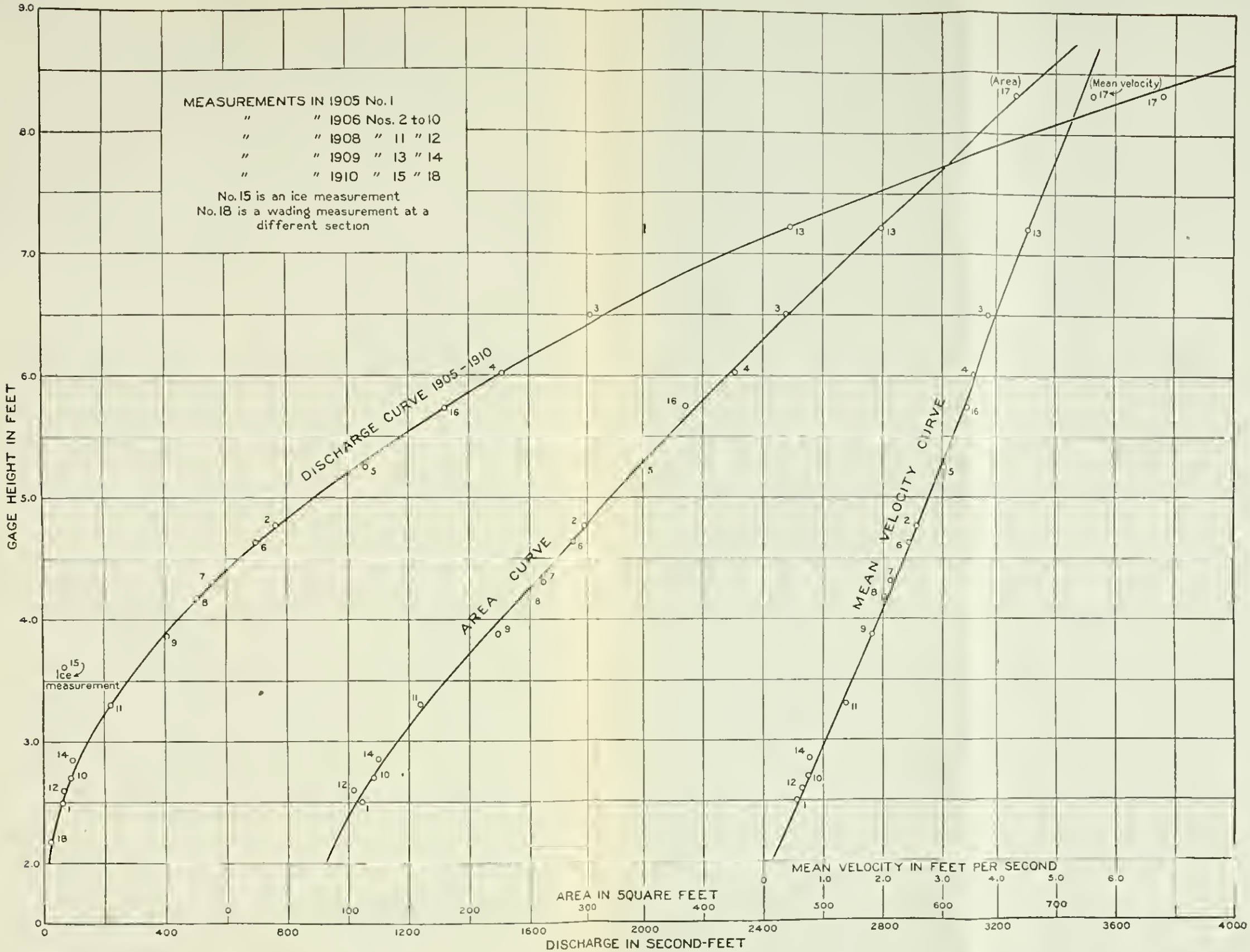
At the end of each year the field or base data for current-meter gaging stations, consisting of daily gage heights, discharge measurements, and full notes, are assembled. The measurements are plotted on cross-section paper and rating curves are drawn wherever feasible. The rating tables prepared from these curves are then applied to the tables of daily gage heights to obtain the daily discharges, and from these applications the tables of monthly discharge and run-off are computed.

Rating curves are drawn and studied with special reference to the class of channel conditions which they represent. (See p. 21.) The discharge measurements for all classes of stations when plotted with gage heights in feet as ordinates and discharges in second-feet as abscissas define rating curves which are more or less generally parabolic in form. In many cases curves of area in square feet and mean velocity in feet per second are also constructed to the same scale of ordinates as the discharge curve. These are used mainly to extend the discharge curves beyond the limits of the plotted discharge measurements, and for checking purposes to avoid errors in the form of the discharge curve and to determine and eliminate erroneous measurements. Plate III shows a typical rating curve.

For every rating table prepared the following assumptions are made for the period to which the table applies: (*a*) That the discharge is a function of and increases gradually with the stage; (*b*) that the discharge is the same whenever the stream is at a given stage, and hence such changes in conditions of flow as may have occurred during the period of application are either compensating or negligible, except that the rating as stated in the footnote of each table is not applicable for known conditions of ice, log jams, or other similar obstructions; (*c*) that the increased and decreased discharge due to change of slope on rising and falling stages is either negligible or compensating.

As already stated, the gaging stations may be divided into several classes, as indicated in the following paragraphs:

The stations of class 1 represent the most favorable conditions for an accurate rating and are also the most economical to maintain. The bed of the stream is usually composed of rock and is not subject to the deposit of sediment and loose material. This class includes also many stations located in a pool below which is a permanent rocky riffle that controls the flow like a weir. Provided the control is sufficiently high and close to the gage to prevent cut and fill at the gaging point from materially affecting the slope of the water surface,



DISCHARGE, AREA, AND MEAN VELOCITY CURVES FOR BIG WOOD RIVER NEAR SHOSHONE, IDAHO.

the gage height will for all practical purposes be a true index of the discharge. Discharge measurements made at such stations usually plot within 2 or 3 per cent of the mean-discharge curve, and the rating developed from that curve represents a very high degree of accuracy. Stations of this type are found in the north Atlantic coast drainage basins.

Class 2 is confined mainly to stations on rough mountainous streams with steep slopes. The beds of such streams are, as a rule, comparatively permanent during low and medium stages, and when the flow is sufficiently well defined by an adequate number of discharge measurements before and after each flood the stations of this class give nearly as good results as those of class 1. As it is seldom possible to make measurements covering the time of change at flood stage, the assumption is often made that the curves before and after the flood converged to a common point at the highest gage height recorded during the flood. Hence, the only uncertain period occurs during the few days of highest gage heights covering the period of actual change in conditions of flow. Stations of this type are found in the upper Missouri River drainage basin.

Class 3 includes most of the current-meter gaging stations maintained by the United States Geological Survey. If sufficient measurements could be made at stations of this class results would be obtained nearly equaling those of class 1, but owing to the limited funds at the disposal of the Survey this is manifestly impossible, nor is it necessary for the uses to which discharge data are applied. The critical points are, as a rule, at relatively high or low stages. Percentage error, however, is greater at low stages. No absolute rule can be laid down for stations of this class. Each rating curve must be constructed mainly on the basis of the measurements of the current year, the engineer being guided largely by the past history of the station and the following general law: If all measurements ever made at a station of this class are plotted on cross-section paper, they will define a mean curve which may be called a standard curve. It has been found in practice that if after a change caused by high stage, a relatively constant condition of flow occurs at medium and low stages, all measurements made after the change will plot on a smooth curve which is practically parallel to the standard curve with respect to the ordinates or gage heights. This law of the parallelism of ratings is the fundamental basis of all ratings and estimates at stations with semipermanent and shifting channels. It is not absolutely correct, but with few exceptions answers all the practical requirements of estimates made at low and medium stages after a change at a high stage. This law appears to hold equally true whether the change occurs at the measuring section or at some controlling point below. The change is of course fundamentally due to change in

the channel caused by cut or fill, or both, at or near the measuring section. For all except small streams the changes in section usually occur at the bottom. The following simple but typical examples illustrate this law:

(*a*) If 0.5 foot of planking were to be nailed on the bottom of a well-rated wooden flume of rectangular section, there would result, other conditions of flow being equal, new curves of discharge, area, and velocity, each plotting 0.5 foot above the original curves when referred to the original gage. In other words, this condition would be analogous to a uniform fill or cut in a river channel which either reduces or increases all three values of discharge, area, and velocity for any gage height. In practice, however, such ideal conditions rarely exist.

(*b*) In the case of a cut or fill at the measuring section there is a marked tendency toward decrease or increase, respectively, of the velocity. In other words, the velocity has a compensating effect, and if the compensation is exact at all stages the discharge at a given stage will be the same under both the new and the old conditions.

(*c*) In the case of uniform change along the crest of a weir or rocky control point, the area curve will remain the same as before the change, and it can be shown that here again the change in velocity curve is such that it will produce a new discharge curve essentially parallel to the original discharge curve with respect to their ordinates.

Of course, in actual practice such simple changes of section do not occur. The changes are complicated and lack uniformity, a cut at one place being largely offset by a fill at another and vice versa. If these changes are very radical and involve large percentages of the total area—as, for example, on small streams—there may result a wide departure from the law of parallelism of ratings. In complicated changes of section the corresponding changes in velocity which tend to produce a new parallel discharge curve may interfere with each other materially, causing eddies, boils, backwater, and radical changes in slope. In such extreme conditions, however, the measuring section would more properly fall under class 4 and would require very frequent measurements of discharge. Special stress is laid on the fact that in the lack of other data to the contrary the utilization of this law will yield the most probable results.

Slight changes at low or medium stages of an oscillating character are usually averaged by a mean curve drawn among them parallel to the standard curve, and if the individual measurements do not vary more than 5 per cent from the rating curve the results are considered good for stations of this class. Stations of this type are found in the south Atlantic coast and eastern Gulf of Mexico drainage basins.

Class 4 comprises stations that have soft, muddy, or sandy beds. Good results can be obtained from such sections only by frequent discharge measurements, the frequency varying from a measurement every two or three weeks to a measurement every day, according to the rate of diurnal change in conditions of flow. These measurements are plotted and a mean or standard curve drawn among them. It is assumed that there is a different rating curve for every day of the year and that this rating is parallel to the standard curve with respect to their ordinates. On the day of a measurement the rating curve for that day passes through that measurement. For days between successive measurements it is assumed that the rate of change is uniform, and hence the ratings for the intervening days are equally spaced between the ratings passing through the two measurements. This method must be modified or abandoned altogether under special conditions. Personal judgment and a knowledge of the conditions involved can alone dictate the course to pursue in such cases. Stations of this type are found in the Platte, Arkansas, Rio Grande, and lower Colorado drainage basins.

The computations have, as a rule, been carried to three significant figures. Computation machines, Crelle's tables, and the 20-inch slide rule have been generally used. All computations are carefully checked.

After the computations have been completed they are entered in tables and carefully studied and intercompared to eliminate or account for all gross errors so far as possible. Missing periods are filled in, so far as is feasible, by means of comparison with adjacent streams. The attempt is made to complete years or periods of discharge, thus eliminating fragmentary and disjointed records. Full notes accompanying such estimates follow the daily and monthly discharge tables.

For most of the northern stations estimates have been made on the monthly discharge during frozen periods. These are based on measurements under ice conditions whenever available, daily records of temperature and precipitation obtained from the United States Weather Bureau climate and crop reports, observers' notes of conditions, and a careful and thorough intercomparison of results with adjacent streams. Although every care possible is used in making these estimates they are often very rough, the data for some of them being so poor that the estimates are liable to as much as 25 to 50 per cent error. It is believed, however, that estimates of this character are better than none at all, and serve the purpose of indicating in a relative way the proportionate amount of flow during the frozen period. These estimates are, as a rule, included in the annual discharge. The large error of the individual months has a

relatively small effect on the annual total, and it is for many purposes desirable to have the yearly discharge computed, even though some error is involved in doing so.

ACCURACY AND RELIABILITY OF FIELD DATA AND COMPARATIVE RESULTS.

Practically all discharge measurements made under fair conditions are well within 5 per cent of the true discharge at the time of observation. Inasmuch as the errors of meter measurements are largely compensating, the mean rating curve, when well defined, is much more accurate than the individual measurements. Numerous tests and experiments have been made to test the accuracy of current-meter work. These show that it compares very favorably with the results from standard weirs, and, owing to simplicity of methods, usually gives results that are much more reliable than those from stations at dams, where uncertainty regarding the coefficient and complicated conditions of flow prevails.

The work is, of course, dependent on the reliability of the observers. With relatively few exceptions the observers perform their work honestly. Care is taken, however, to watch them closely and to inquire into any discrepancies. It is, of course, obvious that one gage reading a day does not always give the mean height for that day. As an almost invariable rule, however, errors from this source are compensating and virtually negligible in a period of one month, although a single day's reading may, when taken by itself, be considerably in error.

The effort is made to visit every station at least once each year for the purpose of making a measurement to determine the constancy of conditions of flow since the last measurement made during the preceding year, and also to check the elevation of the gage. On account of lack of funds or for other causes some stations were not visited during the current year. If conditions of flow have been reasonably permanent up to the time of the last preceding measurement, it is considered best to publish values of discharge on the basis of the latest verified rating curve rather than to omit them altogether, although it should be distinctly understood that such records are at times subject to considerable error. This is also true, although to a less degree, of the period of record since the date of the last measurement of the current year. As a rule the accuracy notes are based on the assumption that the rating curve used is strictly applicable to the current year.

In order to give engineers and others information regarding the probable accuracy of the computed results, footnotes are added to the discharge tables, stating the probable accuracy of the rating tables used, and an accuracy column is inserted in the monthly discharge

table. For the rating tables "well defined" indicates in general that the rating is probably accurate within 5 per cent; "fairly well defined," within 10 per cent; "poorly defined" or " approximate," within 15 to 25 per cent. These notes are very general and are based on the plotting of the individual measurements with reference to the mean rating curve.

The accuracy column in the monthly discharge table does not apply to the maximum or minimum nor to any individual day, but to the monthly mean. It is based on the accuracy of the rating, and probable reliability of the observer, and knowledge of local conditions. In this column A indicates that the mean monthly flow is probably accurate within 5 per cent; B, within 10 per cent; C, within 15 per cent; D, within 25 per cent. Special conditions are covered by footnotes.

USE OF THE DATA.

In general, the policy is followed of making available for the public the base data which are collected in the field each year by the Survey engineers. This is done to comply with the law, and also for the express purpose of giving to any engineer the opportunity of examining the computed results and of changing and adjusting them as may seem best to him. Although it is believed that the rating tables and computed monthly discharges are as good as the base data up to and including the current year will warrant, it should always be borne in mind that the additional data collected at each station from year to year nearly always throw new light on data already collected and published, and hence allow more or less improvement in the computed results of earlier years. It is therefore expected that the engineer who makes serious use of the data given in these papers will verify all ratings and make such adjustments in earlier years as may seem necessary. The work of compiling, studying, revising, and republishing data for different drainage basins for five or ten year periods or more is carried on by the United States Geological Survey so far as the funds for such work are available.

The values in the table of monthly discharge are so arranged as to give only a general idea of the conditions of flow at the station, and it is not expected that they will be used for other than preliminary estimates. The daily discharges are published to allow a more detailed study of the variation in flow and to determine the periods of deficient flow.

COOPERATIVE DATA.

Cooperative data of various kinds and data regarding the run-off at many stations maintained wholly by private funds are incorporated in the surface water-supply reports of the United States Geological Survey.

Many stations throughout the country are maintained for specific purposes by private persons, who supply the records gratuitously to the United States Geological Survey for publication. When such records are supplied by responsible persons and appear to be reasonably accurate they are verified, so far as possible, and estimated values of accuracy are given. Records clearly known to be worthless or misleading are not published. As it is, however, impossible to verify completely all such records furnished—because of lack of funds or for other causes—they are published for what they are worth, because they are of value as a matter of record and afford at least approximate information regarding stream flow at the particular localities. The Survey does not, however, assume any responsibility for inaccuracies found in such records, although most of them are believed to be reasonably good.

COOPERATION AND ACKNOWLEDGMENTS.

During 1909 the work in Oregon, Washington, Idaho, and Montana was done under cooperative agreements between the United States Geological Survey and the respective States.

In this work the State is the chief beneficiary, for its interest in obtaining a thorough and reliable knowledge of its water resources is paramount. At a very moderate cost for field work the State procures the services of men already trained in collecting and analyzing the fundamental data, and after the material has been gathered it is published without additional expense on the part of the State.

In general the cooperative agreements specify that the United States Geological Survey shall allot from its appropriation a sum equal to that appropriated from State funds; but to obtain results at all commensurate with public needs it has been necessary to expend a much larger sum.

The United States Reclamation Service, which is a heavy investor in the development of the water resources of the Western States, has been so handicapped by a lack of physical data that it has been forced to expend from its own fund considerable money for investigations of this kind. The United States Indian Office also in the development of projects for the benefit of the Indians, has found it necessary to make certain investigations of water supply. As these investigations are closely allied with the collection of statistics of rain and snowfall, the cooperation of the United States Weather Bureau has been enlisted to a small extent. The engineers of the Geological Survey in their regular field work are able to install and inspect some of the rainfall stations maintained by the Weather Bureau with but little loss of time. Under agreements with the Reclamation Service and with the Office of Indian Affairs the work has been performed

under the direction of the engineers of the Geological Survey. Careful cost accounts have been kept of this work and repayments made to the Geological Survey of the amounts represented.

COOPERATION IN OREGON.

In 1905, the Oregon Legislature passed an act providing for an annual appropriation of $2,500 for the investigation of water resources within the State, contingent upon an equal allotment by the United States Geological Survey for similar investigations. The State engineer represents the State in this cooperation and each year makes an agreement with the Director of the Geological Survey. The principal features of this agreement are:

1. The United States Geological Survey assumes the responsibility of gathering, analyzing, and publishing the data.

2. Field notes, maps, etc., and all data gathered as a result of field studies are at all times open to inspection of the State engineer, and if they are not entirely satisfactory the agreement can be terminated at any time.

3. Salaries of classified employees and the cost of nonexpendable equipment are paid from Government funds, while traveling expenses, salaries and expenses of field assistants, cost of expendable supplies, etc., are paid from the State funds. In this manner practically the entire amount of the State's appropriation is expended within the State.

4. The cost of publication is borne entirely by the Geological Survey.

During the calendar year 1909 the total expense for water-supply investigations from Government and State funds in Oregon was $8,606.66. This amount was distributed among the several cooperating bureaus as follows:

Expenditures for hydrographic work in Oregon, calendar year 1909.

United States Geological Survey	$2,558.59
United States Reclamation Service	3,289.95
Office of Indian Affairs	193.86
United States Weather Bureau	66.02
Total Government funds	6,108.42
State of Oregon cooperative fund	2,498.24

The cost of hydrographic work has frequently been a subject of inquiry. In this connection the following data will be of interest:

Cost of hydrographic work in Oregon, calendar year 1909.

Total expenditure for maintenance of river stations and allied investigations	$8,606.66
Number of stations maintained	86
Cost per station	$100
Number of stream gagings made	166
Cost per gaging	$52

Distribution of expenditures.

	Amount.	Per cent.
Field services	$3,996.00	47
Office services	1,588.09	18
Traveling expenses	1,594.02	19
Supplies and equipment	356.29	4
Lost time (Sundays, holidays, etc.)	638.99	7
Rent and storage	262.20	3
General	171.07	2

The inordinately high average cost of each discharge measurement in Oregon—$52—is very simply explained. In previous years more funds were available and a larger number of stations were installed than could be maintained by the funds allotted in 1909. To avoid interrupting the continuity of records, the field work was eliminated except in that part of central Oregon where cooperative agreements with the Reclamation Service made it possible to continue the work; in the other parts of the State the money was expended for the payment of gage observers, with the expectation that when additional funds are available a sufficient number of discharge measurements can be made at these stations to enable the computation of discharge.

COOPERATION IN WASHINGTON.

The legislature of Washington passed an act in 1909 containing the following section:

> In order to complete the topographic map of the State of Washington, and for the purpose of making more extensive stream measurements and otherwise investigating and determining the water supply of the State, there is hereby appropriated the sum of $30,000 for cooperation with those branches of the United States Geological Survey engaged in this work. This appropriation, however, shall be contingent upon and not become available unless the United States Government appropriates an equal amount to be expended for similar purposes within the State. The Board of Geological Survey is hereby authorized and directed to enter into such agreements with the Director of the United States Geological Survey as will insure that the said surveys and investigations be carried on in the most economical manner, and that the maps and data be available for the use of the public as quickly as possible.

The appropriation of $30,000 was for two years' work. The division of the amount between topographic surveys and water-supply investigations was left open to agreement. It was agreed that the sum of $10,000 should be expended for the former and $5,000 for the latter during the fiscal year 1910. In the State of Washington the Board of Geological Survey is made the cooperating agent. This board is represented by the State geologist, Henry Landes. The agreements entered into between the Director of the United States Geological Survey and the Washington State Board of Geological Survey were similar to that cited for the cooperative work in Oregon.

A systematic study of the available water power in Washington was also begun under the cooperative agreement. The area to be

investigated first is the Cascade Range and the first unit of this area is the southern portion. Surveys of the principal rivers draining that portion of the Cascade Range south of Mount Rainier were made during the fieldseason of 1909. River profiles were made and the low-water discharge of the streams determined at critical points. On each stream surveyed a gaging station was installed in addition to the temporary ones. The results from these permanent stations for subsequent years can be compared with those obtained at the temporary stations during the summer season of 1909. The results of these power investigations and the maps accompanying them will be published in special water-supply papers.[1]

The following tables give the cost of water resources investigations in the State during 1909 and the distribution of these expenses. The $5,000 appropriated by the State was largely used for water-power surveys. Agreements did not go into effect until June 1. The total expenditures were $13,277.54, distributed as follows:

Expenditures for hydrographic work in Washington, calendar year 1909.

United States Geological Survey	$3,199.58
United States Reclamation Service	5,462.90
Office of Indian Affairs	471.27
Total Government funds	9,133.75
State of Washington cooperative fund	4,143.79

Cost of hydrographic work in Washington, calendar year 1909.

Total expenditure for maintenance of river stations and allied investigations:	
Maintenance of gaging stations	$9,101.68
River surveys	$4,175.86
Number of stations maintained	85
Cost per station	$107
Number of gagings made	508
Cost per gaging	$18
Miles of rivers surveyed	248.1
Cost per mile	$17

Distribution of expenditures.

	Amount.	Per cent.
Field services	$5,207.22	40
Office services	2,326.17	17
Traveling expenses	3,096.63	23
Supplies and equipment	1,386.49	10
Lost time (Sundays, holidays, etc.)	946.11	7
Rent and storage	202.05	2
General	112.87	1

[1] Stevens, J. C., Water powers of the Cascade Range, pt. 1, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

COOPERATIVE WORK IN COLUMBIA RIVER DRAINAGE BASIN, MONT.

The work in the Columbia River drainage basin in Montana is carried on largely in cooperation with the United States Reclamation Service. The work is confined entirely to streams in connection with reclamation projects on Flathead River and its tributaries. With the exception of a few observers paid by the Geological Survey and the State of Montana, the entire cost of the work is borne by the Reclamation Service.

The following is a statement of the amounts and a distribution of the expenditures:

Expenditures for hydrographic work in Columbia River drainage basin, Montana, calendar year 1909.

United States Geological Survey	$60.00
United States Reclamation Service	1,027.67
Total Government funds	1,087.67
Amount paid by State of Montana	190.00

Cost of hydrographic work in the Columbia River drainage basin in Montana.

Total expenditures for maintenance of river stations	$1,277.67
Number of stations maintained	14
Cost per station	$91.26
Number of stream gagings made	45
Cost per gaging	$28.39

Distribution of expenditures.

	Per cent.
Field services	54
Office services	18
Traveling expenses	23
Supplies and equipment	.2
Lost time (Sundays, holidays, etc.)	5
Rent and storage	.2

COOPERATIVE WORK IN IDAHO.

The State of Idaho, acting under authority given by the legislature of 1909 through its State land board, appropriated the sum of $2,000, contingent upon the expenditure by the United States of an equal amount, for the investigation of the water resources of the State.

On July 1, 1909, a contract was entered into between the State engineer, representing the State of Idaho, and the Director of the Geological Survey, representing the United States. This contract provided for the expenditure of $2,000 by each party during the 12 months from July 1, 1909, to June 30, 1910, for the purpose of making this investigation. The principal features of the contract are practically the same as those of the contract with the State of Oregon (p. 33).

The following is a brief summary of the distribution of the Idaho expenditures for hydrometric work during the calendar year 1909:

Expenditures for hydrographic work in Idaho, calendar year 1909.

United States Geological Survey	$1,944.63
United States Reclamation Service	3,916.20
United States Office of Indian Affairs	1,012.75
Total expenditure from Government funds	6,873.58
Spent from State of Idaho funds	872.22
Total expenditure within the State	7,745.80

Cost of hydrographic work in Idaho, calendar year 1909.

Total expenditures for maintenance of river stations and allied investigations	$7,745.80
Number of stations maintained	25
Cost per station	$309.83
Number of stream gagings made	230
Cost per gaging	$33.68

SPECIAL ACKNOWLEDGMENTS.

Special acknowledgments are due to John H. Lewis, State engineer of Oregon; to Henry Landes, State geologist of Washington, and to James Stevenson, jr., State engineer of Idaho, for the very efficient manner in which they represented their respective States in the cooperative investigations.

Acknowledgments are due to the engineers and employees of the United States Reclamation Service and of the United States office of Indian Affairs for assistance, suggestions, and the freest use of data gathered exclusively for them and for which they have paid. Acknowledgments are also due to the Corps of Engineers, United States Army, and the officers of the United States Weather Bureau for hydrographic and climatologic data. A number of irrigation and power companies, several railroad companies, and many individuals have cooperated in the maintenance of many stations and have cheerfully furnished much valuable information; for assistance and suggestions thus rendered acknowledgment is hereby made.

DIVISION OF WORK.

The field data in the Columbia River basin in Oregon and Washington, the Puget Sound drainage area, and the Pacific Ocean drainage area in Oregon were collected by J. C. Stevens, district engineer, H. D. McGlasham, L. R. Allen, Howard Kimble, R. B. Post, and C. W. Harris.

The field data for the Snake River drainage area in Idaho have been collected by E. C. La Rue, district engineer, E. S. Fuller, O. W. Hartwell, W. N. O'Neill, G. T. Burridge, H. L. Stoner, and O. C. Finkelnburg.

The field data for the Clark Fork drainage area in Montana have been collected by J. E. Stewart and W. A. Lamb, district engineers, and Raymond Richards.

The ratings, special estimates, and analyses of completed data were made by J. C. Stevens, E. C. La Rue, W. A. Lamb, and F. F. Henshaw. The computations and final preparation of the completed data for publication were made under the direction of F. F. Henshaw, assistant engineer, by G. C. Stevens, R. C. Rice, J. G. Mathers, H. J. Jackson, L. T. King, M. E. McChristie, H. D. Padgett, J. J. Phelan, E. H. Swett, L. R. Allen, and M. I. Walters. The manuscript has been edited by Mrs. B. D. Wood.

GAGING STATIONS IN NORTH PACIFIC COAST DRAINAGE BASINS.

The following is a list of gaging stations maintained in the north Pacific coast drainage basins by the United States Geological Survey and cooperative parties. The stations are arranged by river basins, in downstream order, as explained on page 17, tributaries being indicated by indention. Data for these stations have been published in the reports listed in tables on pages 14–16.

Stations in Pacific coast drainage basins.

Between California State line and Columbia River.

Rogue River (North Fork) at Prospect, Oreg., 1907–8.
Rogue River near Tolo, Oreg., 1905–1909.
Rogue River near Galice, Oreg., 1906.
    Little Butte Creek at Eagle Point, Oreg., 1907–1909.
    Bear Creek at Talent, Oreg., 1907–1909.
    Applegate Creek at Murphy, Oreg., 1907–1909.
Umpqua River (South Fork) near Brockway, Oreg., 1905–1909.
Umpqua River near Elkton, Oreg., 1905–1909.
    Umpqua River (North Fork) near Oak Creek and Winchester, Oreg., 1905–1909.
    Mill Creek near Ash, Oreg., 1907–1909.
Siletz River at Siletz, Oreg., 1905–1909.

Columbia River.

Columbia River near Julia, Wash., 1905.
Columbia River near Pasco, Wash., 1904–1909.
Columbia River at Cascade Locks and The Dalles, Oreg., 1879–1909.
    Clark Fork at Missoula, Mont., 1898–1907.
    Clark Fork at Priest River, Idaho, 1903–1905.
    Clark Fork at Newport, Wash., 1904–1909.
    Clark Fork at Metaline, Wash., 1908–9.
        Big Blackfoot River at Bonner, Mont., 1898–1905.
            Rattlesnake Creek at Missoula, Mont., 1899–1900.
        Bitterroot River near Grantsdale, Mont., 1902–1907.
        Bitterroot River near Missoula, Mont., 1898–1901, 1903–4.
        Flathead River at Demersville near Kalispell, Mont., 1909.
        Flathead River at Damon's ranch near Kalispell, Mont., 1909.

Columbia River—Continued.
Clark Fork—Continued.
Flathead River at Holt, Mont., 1909.
Flathead Lake at Holt, Mont., 1900.
Flathead Lake at Polson, Mont., 1900–1901, 1908–9.
Flathead River near Polson, Mont., 1907–1909.
Stillwater River near Kalispell, Mont., 1906–7.
Whitefish River near Kalispell, Mont., 1906.
Little Bitterroot Creek near Hubbart, Mont., 1909.
Little Bitterroot Creek near Dayton, Mont., 1908–9.
Crow Creek near Ronan, Mont., 1906–1909.
Mud Creek near Ronan, Mont., 1908–9.
Mission Creek near St. Ignatius, Mont., 1906–1909.
Dry Creek near St. Ignatius, Mont., 1908–9.
Post Creek near St. Ignatius, Mont., 1906–1909.
Jocko River near Jocko, Mont., 1908–9.
Jocko River at Ravalli, Mont., 1906–1909.
Big Knife Creek near Jocko, Mont., 1908–9.
Agency Creek near Jocko, Mont., 1908–9.
Blodgett Creek near Jocko, Mont., 1909.
Finley Creek near Jocko, Mont., 1908–9.
East Finley Creek near Jocko, Mont., 1908–9.
Indian Ditch near Jocko, Mont., 1908–9.
Valley Creek near Ravalli, Mont., 1908–9.
Kootenai River near Bonners Ferry, Idaho, 1904.
Kootenai River near Porthill, Idaho, 1904.
Cœur d'Alene Lake (head of Spokane River) at Cœur d'Alene, Idaho, 1903–1909.
Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., 1891–1896.
Spokane River at Spokane, Wash., 1896–1909.
Hangman Creek at and near Tekoa, Wash., 1903–1905.
Hangman Creek (North Fork) near Spokane, Wash., 1904–5.
Little Spokane River near Spokane, Wash., 1903–1905.
Okanogan River:
Sinlahekin Creek near Loomis, Wash., 1903–1905.
Johnson Creek near Riverside, Wash., 1903–1907.
Salmon Creek near Malott, Wash., 1903–1909 (now called "near Okanogan").
Methow River at Pateros, Wash., 1903–1909.
Chelan Lake (head of Chelan River) at Lakeside, Wash., 1897–1899, 1905.
Chelan River at Chelan, Wash., 1903–1909.
Wenatchee River at Sherman Spur above Cashmere, Wash., 1904–1909.
Wenatchee River at Cashmere, Wash., 1904–1909.
Wenatchee River at Wenatchee, Wash., 1897.
Crab Creek at Wilson Creek, Wash., 1904.
Crab Creek near Ephrata, Wash., 1909.
Moses Lake at Moses Lake, Wash. (gage heights and evaporation records), 1909.
Crab Creek near Warden, Wash., 1909.
Keechelus Lake (on Yakima River) near Martin, Wash., 1906–1909.
Yakima River near Martin, Wash., 1903–1909.
Yakima River at Easton, Wash., 1904.
Yakima River at Clealum, Wash., 1906–1909.
Yakima River at Umtanum, Wash., 1906–1909.
Yakima River at Selah Gap near North Yakima, Wash., 1897–8, 1904–5.
Yakima River at Union Gap, near Yakima, Wash., 1893–1909.
Yakima River near Wapato, Wash., 1908–9.

Columbia River—Continued.
- Yakima River at Prosser, Wash., 1904–1906.
- Yakima River at Kiona, Wash., 1895–1909.
- Yakima River near Richland, Wash., 1906–1909.
  - Cabin Creek near Easton, Wash., 1909.
  - Kachess Lake (on Kachess River) near Easton, Wash., 1905–1909.
  - Kachess Lake evaporation records, 1907–1909.
  - Kachess River near Easton, Wash., 1903–1909.
  - Big Creek near Clealum, Wash., 1909.
  - Clealum River (North Fork) at Galena, Wash., 1907.
  - Clealum Lake near Roslyn, Wash., 1906–1909.
  - Clealum River near Roslyn, Wash., 1903–1909.
  - Teanaway River near Clealum, Wash., 1909.
  - Swauk Creek near Clealum, Wash., 1909.
  - Taneum Creek near Thorp, Wash., 1909.
  - Manastash Creek near Ellensburg, Wash., 1909.
  - Wenas Creek near Selah, Wash., 1909.
  - Naches River at Anderson's ranch above Nile, Wash., 1909.
  - Naches River near Nile, Wash., 1904–1909.
  - Naches River below Tieton River near Naches, Wash., 1905, 1909.
  - Naches River near North Yakima, Wash., 1893–1909.
    - Bumping Lake (on Bumping River) near Nile, Wash., 1909.
    - Bumping River at Bumping Lake near Nile, Wash., 1906–7, 1909.
      - American River near Nile, Wash., 1909.
    - Tieton River at McAllister Meadows near Naches, Wash., 1908–9.
    - Tieton River at headworks of Tieton Canal near Naches, Wash., 1906–1909.
    - Tieton River near Naches, Wash., 1902–1909.
  - Atanum Creek (North Fork) near Tampico, Wash., 1907–1909.
  - Atanum Creek at The Narrows, near Tampico, Wash., 1908–9.
  - Atanum Creek near Yakima, Wash., 1904–1909.
    - Atanum Creek (South Fork) near Tampico, Wash., 1907–1909.
  - Toppenish Creek near Fort Simcoe, Wash., 1909.
  - Toppenish Creek near Wapato, Wash., 1909.
  - Toppenish Creek near Toppenish, Wash., 1908–9.
  - Toppenish Creek at Alfalfa, Wash., 1909.
    - Simcoe Creek near Fort Simcoe, Wash., 1909.
  - Satas Creek near Alfalfa, Wash., 1908–9.
  - Canals in Yakima Valley:

Kittitas Valley.

- Cascade canal near Thorp, Wash., 1905, 1909.
- West Kittitas canal near Thorp, Wash., 1904, 1909.
- Ellensburg Water Co.'s canal near Ellensburg, Wash., 1909.
- Town canal near Ellensburg, Wash., 1904–5.
- Olson canal near Ellensburg, Wash., 1905, 1909.
- Bull canal near Ellensburg, Wash., 1909.

Yakima and Moxee valleys.

- Selah-Moxee canal near Selah, Wash., 1904–5, 1909.
- Taylor canal near Selah, Wash., 1905, 1909.
- Moxee canal near North Yakima, Wash., 1904–5, 1909.
- Hubbard canal near North Yakima, Wash., 1904–5, 1909.
- Fowler canal near North Yakima, Wash., 1904–5, 1909.
- Granger canal near North Yakima, Wash., 1904, 1909.

Columbia River—Continued.
Yakima River—Continued.
Canals in Yakima Valley—Continued.

Indian Reservation basin.

New Reservation canal near Yakima, Wash., 1904–1909.
Old Reservation canal near Wapato, Wash., 1904–1909.
Sunnyside canal near Wapato, Wash., 1904–1909.
Sunnyside canal at Zillah, Wash., evaporation records, 1907–8.
Gilbert canal near Toppenish, Wash., 1904.
Hatch canal near Toppenish, Wash., 1904.

Lower Yakima River.

Prosser Falls Irrigation Co.'s power canal at Prosser, Wash., 1904.
Benton Water Co.'s canal near Kiona, Wash.,1905.
Kiona canal near Kiona, Wash., 1904–5 and 1908–9.
Kiona Water Supply Co.'s canal near Kiona, Wash., 1905.
Kennewick canal near Kennewick, Wash., 1904–5.
Grosscup canal near Kiona, Wash., 1905.

Diversions from Naches River above Tieton River.

Selah Valley canal near Naches, Wash., 1904–5.

Diversions from Naches River between Tieton River and Cowiche Creek.

Wapatox canal, upper and lower, near Naches, Wash., 1904–5, 1909.
Clark canal near Naches, Wash., 1905, 1909.
Upper Scott canal near Naches, Wash., 1909.
Lowery canal near Naches, Wash., 1905, 1909.
Kelly canal near Naches, Wash., 1909.
Fortune canal near Naches, Wash., 1905, 1909.
Lower Scott canal near Naches, Wash., 1905, 1909.
Gleed canal near Naches, Wash., 1904–5, 1909.
Morrisey canal near Naches, Wash., 1909.
Congdon (Yakima Valley) canal near Naches, Wash., 1904–5, 1909.
White and Leach canal near Naches, Wash., 1905, 1909.
McCormick canal near Naches, Wash., 1905, 1909.
Schuler and Rodenbach canal near North Yakima, Wash., 1909.
Naches-Cowiche canal near North Yakima, Wash., 1904–5.

Diversions from Naches River below Cowiche Creek.

Power canal at North Yakima, Wash., 1904–5.
Fruitvale-Schanno canal at North Yakima, Wash., 1909.
R. S. and C. canal at North Yakima, Wash., 1909.
Schanno canal at North Yakima, Wash., 1904–5, 1909.
Broadgage canal near North Yakima, Wash., 1904–5, 1909.
Union canal at North Yakima, Wash., 1904, 1909.
North Yakima Town canal at North Yakima, Wash., 1904, 1909.

Jackson Lake (on Snake River, South Fork) near Moran, Wyo., 1908.
Snake River (South Fork) at Moran, Wyo., 1903–1909.
Snake River (South Fork) at Grovant, Wyo., 1899.
Snake River (South Fork) near Lyon, Idaho, 1903–1909.
Snake River at Idaho Falls, Idaho, 1889–1893.
Snake River at Neeley, Idaho, 1906–1909.
Snake River near Minidoka, Idaho, 1895–1899, 1901–1909.
Snake River at Milner, Idaho, 1909.
Snake River at King Hill, Idaho, 1909.
Snake River at Burbank, Wash., 1907–1909.
Buffalo River near Elk, Wyo., 1906.
Pacific Creek near Moran, Wyo., 1906.

Columbia River—Continued.
Snake River—Continued.
Snake River (North Fork) near Ora, Idaho, 1902–1909.
Snake River (North Fork) at Ferry, Idaho, 1890.
Snake River (North Fork) near Rexburg, Idaho, 1909.
Fall River near Marysville, Idaho, 1902–3.
Fall River at Fremont, Idaho, 1904–1909 (replaces the Marysville station).
Fall River in Canyon, Idaho, 1890–1901.
Teton River near St. Anthony, Idaho, 1903–1909.
Teton River at Chase's ranch, Idaho, 1890–1893.
Willow Creek near Prospect, Idaho, 1904.
Blackfoot River near Rossfork, Idaho, 1908–9 (now called "near Henry").
Blackfoot River near Shelley, Idaho, 1909.
Blackfoot River near Presto, Idaho, 1903–1909.
Big Lost River near Chilly, Idaho, 1904–1909.
Big Lost River near Mackay, Idaho, 1903–1906.
Port Neuf River at Pocatello, Idaho, 1897–1899.
Raft River near Bridge, Idaho, 1909.
Cassia Creek near Conant, Idaho, 1909.
Goose Creek near Oakley, Idaho, 1909.
Big Cottonwood Creek near Oakley, Idaho, 1909.
Rock Creek at Rock Creek, Idaho, 1909.
Salmon Falls River near San Jacinto, Nev., 1909.
Salmon Falls River near Twin Falls, Idaho, 1909.
Cedar Creek near Roseworth, Idaho, 1909.
Big Wood River near Gimlet, Idaho, 1904–5.
Big Wood River near Hailey, Idaho, 1889.
Big Wood River at Toponis, Idaho, 1896–1899.
Big Wood River near Shoshone, Idaho, 1905–6, 1908–9.
Big Wood River near Bliss, Idaho, 1899.
Little Camas Creek at Little Camas Store, Idaho, 1896.
Little Wood River near Carey, Idaho, 1904–5.
Little Wood River at Toponis, Idaho, 1896–1899.
Little Canyon Creek at Glenns Ferry, Idaho, 1909.
Alkali Creek near Glenns Ferry, Idaho, 1909.
Cold Spring Creek near Medbury, Idaho, 1909.
Bennetts Creek near Medbury, Idaho, 1909.
Bruneau River near Hot Spring, Idaho, 1909.
Bruneau River near Grandview, Idaho, 1895–1903, 1909.
Succor Creek near Homedale, Idaho, 1903–1909.
Owyhee River at Owyhee, Oreg., 1890–1896, 1903–1909.
Boise River near Highland, Idaho, 1905–1909 (replaces the Boise station).
Boise River near Boise, Idaho, 1894–1904.
Boise River at Caldwell, Idaho, 1895–6.
Malheur River near Harper's ranch, near Westfall, Oreg., 1903–1905.
Malheur River at McLaughlin's bridge, near Vale, Oreg., 1904–1906.
Malheur River at Vale, Oreg., 1890–1, 1895–6, 1903–1909.
Malheur River at Halliday's bridge, near Ontario, Oreg., 1904–5.
Malheur River (Middle Fork) above South Fork at Riverside, Oreg., 1906, 1908–9.
Malheur River (Middle Fork) below South Fork at Riverside, Oreg., 1909.
Malheur River (North Fork) near Beulah, Oreg., 1909.
Bully Creek at Warm Springs above Vale, Oreg., 1905–1907.
Bully Creek at Vale, Oreg., 1904–5.

Columbia River—Continued.
Snake River—Continued.
Malheur River—Continued.
Willow Creek near Prospect, Idaho, 1903.
Willow Creek near Malheur, Oreg., 1904–1906.
Willow Creek at Dell, Oreg., 1904–1906.
Payette River near Horseshoe Bend, Idaho, 1906–1909.
Payette River at Payette, Idaho, 1895–1897.
Payette River (North Fork) at Lardo, Idaho, 1908–9.
Payette River (Lake Fork) near McCall, Idaho, 1909.
Weiser River above Weiser, Idaho, 1890–1891.
Weiser River at Weiser, Idaho, 1895–1904.
Powder River at Salisbury, Oreg., 1903–1909.
Powder River near North Powder, Oreg., 1909.
Eagle Creek near Baker City, Oreg., 1909.
Grande Ronde River at Hilgard, Oreg., 1903–1909.
Grande Ronde River at Elgin, Oreg., 1903–1909.
Grande Ronde River at Zindel, Wash., 1904–1909.
Catherine Creek near Union, Oreg., 1906–7.
Wallowa River at Joseph, Oreg., 1903–1909.
Wallowa River near Wallowa, Oreg., 1903–1907.
Wallowa River near Elgin, Oreg., 1903–1909.
Asotin Creek at Shelman's ranch, near Asotin, Wash., 1904–1906.
Asotin Creek near Asotin, Wash., 1904–5.
Palouse River at Elberton, Wash., 1904–5.
Palouse River at Hooper, Wash., 1897–1909.
Rock Creek near St. John, Wash., 1903–1905.
Cow Creek near Keystone, Wash., 1904–5.
Cow Creek at Hooper, Wash., 1904.
Canals in Snake River basin:

Upper Snake River basin.

North side Minidoka canal near Minidoka, Idaho, 1909.
South side Minidoka canal near Minidoka, Idaho, 1909.
North side Twin Falls canal near Milner, Idaho, 1909.
South side Twin Falls canal near Milner, Idaho, 1909.

Lower Snake River basin.

Wilson ditch near Ontario, Oreg., 1904–5.

Owyhee River basin.

Owyhee ditch near Owyhee, Oreg., 1905.

Malheur River basin.

Vines ditch above Vale, Oreg., 1904–5.
Malheur Farmers' canal above Vale, Oreg., 1904–5.
McLaughlin ditch above Vale, Oreg., 1904–5.
"J. H." ditch above Vale, Oreg., 1904–5.
Gellerman & Frohman ditch above Vale, Oreg., 1904–5.
Sand Hollow ditch above Vale, Oreg., 1904–5.
Hope Mill ditch at Vale, Oreg., 1905.
Nevada ditch below Vale, Oreg., 1904–5.

Wallowa River basin.

Silver Lake ditch near Joseph, Oreg., 1905.
Farmers and Citizens' ditch near Joseph, Oreg., 1905.
Granger ditch at Joseph, Oreg., 1905–6.
Big Bend ditch at Joseph, Oreg., 1905.
Company ditch near Wallowa, Oreg., 1905.

Columbia River—Continued.
Walla Walla River near Milton, Oreg., 1903–1909.
Walla Walla River at Whitman, Wash., 1897–1899.
Walla Walla River (South Fork) near Milton, Oreg., 1903–1909.
Umatilla River at Gibbon, Oreg., 1896–1909.
Umatilla River at Pendleton, Oreg., 1891–1892, 1903–1905.
Umatilla River near Yoakum, Oreg., 1903–1909.
Umatilla River near Umatilla, Oreg., 1903–1909.
McKay Creek near Pendleton, Oreg., 1903–4.
Canals in Umatilla River basin:
Farmers' mill ditch at Pendleton, Oreg., 1906.
Slusher & Gould ditch near Nolin, Oreg., 1905.
Lisle & Crane ditch near Echo, Oreg., 1905.
Charles Lisle ditch at Echo, Oreg., 1905.
Henrietta mill ditch at Echo, Oreg., 1905.
Wilson & Co.'s ditch at Echo, Oreg., 1905.
Allen ditch at Echo, Oreg., 1905.
Hinckle ditch at Echo, Oreg., 1905.
Pioneer ditch at Echo, Oreg., 1905.
Maxwell ditch at Echo, Oreg., 1905.
Hermiston ditch near Hermiston, Oreg., 1905.
Beitle ditch near Hermiston, Oreg., 1905.
Oregon Land & Water Co.'s ditch at Umatilla, Oreg., 1905.
Brownell ditch at Umatilla, Oreg., 1905.
Willow Creek near Arlington, Oreg., 1905–6.
John Day River near Dayville, Oreg., 1908–9.
John Day River at McDonald, Oreg., 1904–1909.
John Day River (South Fork) at Dayville, Oreg., 1908–9.
Rock Creek near Arlington, Oreg., 1905.
Deschutes River at Allen's ranch near Lava, Oreg., 1905, 1908–9.
Deschutes River at West's ranch near Lava, Oreg., 1906–1909.
Deschutes River at Benham Falls, Oreg., 1909.
Deschutes River at Bend, Oreg., 1904–1909.
Deschutes River at Laidlaw, Oreg., 1909.
Deschutes River at Moro, Oreg., 1897–1899.
Deschutes River near Biggs, Oreg., 1906–1909. (Replaces Moro station.)
Deschutes River (East Fork) at Crescent, Oreg., 1904–1908.
Deschutes River (West Fork) near Lava, Oreg., 1905–1907, 1909.
Tumalo Creek near Laidlaw and Bend, Oreg., 1906–1909.
Lewis Creek near Laidlaw, Oreg., 1908–9.
Squaw Creek and McAllister ditch near Sisters, Oreg., 1907–1909.
Crooked River near Post, Oreg., 1908–9.
Crooked River near Prineville, Oreg., 1908–9.
Ochoco Creek and Elliot ditch near Prineville, Oreg., 1908–9.
Metolius River near Sisters, Oreg., 1908–9.
Canals in Deschutes River basin:
Central Oregon and Pilot Butte canals near Bend, Oreg., 1905–1909.
Wimer canal near Laidlaw, Oreg., 1906–1909.
Columbia Southern canal near Laidlaw, Oreg., 1906–1909.
Klickitat River above and below Big Muddy River near Klickitat, Wash., 1905, 1907–8.
Klickitat River at Camp Klickitat, Wash., 1908–9.
Klickitat River at Hanson's cable, near Klickitat, Wash., 1908–9.
Klickitat River at Wels Ferry, near Lyle, Wash., 1908–9.

Columbia River—Continued.
- Klickitat River at Klickitat, Wash., 1907, 1909.
  - Big Muddy River above mouth of Cougar Creek near Klickitat, Wash., 1905, 1908.
- Hood River at Tuckers Bridge, Wash., 1897–1899.
- Hood River at Winans, Wash., 1905–1907.
- White Salmon River at Husum, Wash., 1909.
  - Trout Creek at Guler, Wash., 1909.
- Little White Salmon River below Lava Creek near Cooks, Wash., 1903–1906.
- Little White Salmon River near Cooks, Wash., 1909.
- Sandy River at Salmon, Oreg., 1908–9.
  - Bull Run River near Bullrun, Oreg., 1907–1909.
- Willamette River (Middle Fork) at Jasper, Oreg., 1905–1909.
- Willamette River at Albany, Oreg., 1895–1909.
- Willamette River at Oregon City, Oreg., 1909.
  - Willamette River (Middle Fork):
    - Willamette River (North Fork of Middle Fork) near Hazeldell, Oreg., 1909.
    - Kelsey River near Hazeldell, Oreg., 1909.
  - Willamette River (Coast Fork) near Goshen, Oreg., 1905–1909.
  - McKenzie River near Springfield, Oreg., 1905–1909.
- Santiam River (North Fork) at Detroit, Oreg., 1907–1909.
- Santiam River (North Fork) at Mehama, Oreg., 1905–1907.
- Santiam River at Jefferson, Oreg., 1905–6, 1908–9.
  - Santiam River (Marion Fork) at Marion Lake near Detroit, Oreg., 1907, 1909.
  - Puzzle Creek near Detroit, Oreg., 1907, 1909.
  - Permelia Creek near Detroit, Oreg., 1907, 1909.
  - Whitewater Creek near Detroit, Oreg., 1907.
  - Santiam River (South Fork) at Waterloo, Oreg., 1905–1907.
  - Luckiamute River near Suver, Oreg., 1905–1909.
  - Yamhill River (South Fork) at Sheridan, Oreg., 1906–1909.
  - Yamhill River at La Fayette, Oreg., 1908–9.
  - Molalla River near Molalla, Oreg., 1905–1909.
  - Clackamas River near Cazadero, Oreg., 1909.
  - Clackamas River near Cazadero, Oreg., evaporation records, 1909.
  - Clackamas River at Estacada, Oreg., 1908–9.
  - Clackamas River near Barton, Oreg., 1905–1908. (Replaced by Estacada Station.)
- Lewis River above Muddy River near Cougar, Wash., 1909.
- Lewis River at Peterson's Ranch near Cougar, Wash., 1909.
- Lewis River at Ariel, Wash., 1909.
  - Muddy River at mouth near Cougar, Wash., 1909.
  - Pine Creek at mouth near Cougar, Wash., 1909.
  - Swift Creek at mouth near Cougar, Wash., 1909.
- Cowlitz River:
  - Toutle River at St. Helens, Wash., 1909.
  - Toutle River near Castle Rock, Wash., 1909.

Columbia River to Puget Sound.

Soleduck River near Quillayute, Wash., 1891–1901.
- Kalawa River near Forks, Wash., 1897–1901.

Elwha River at McDonald, Wash., 1897–1901.

Stations in Puget Sound drainage basins.

Dungeness River at Dungeness, Wash., 1897–1901.
White River near Buckley, Wash., 1899–1902.

White River—Continued.
Cedar River at Vaughn Bridge near Cedar Lake, Wash., 1898.
Cedar River at Cedar Lake near Northbend, Wash., 1902, 1903.
Cedar River near Ravendale, Wash., 1902–1909.
Cedar River near Seattle, Wash., 1895–1898.
Snoqualmie River at Snoqualmie Falls, Wash., 1902–1906.
Stilaguamish River near Robe, Wash., 1902.
Skykomish River (South Fork) at Index, Wash., 1902–1905.
Skagit River near Marblemount, Wash., 1909.
Cascade River near Marblemount, Wash., 1909.

ROGUE RIVER DRAINAGE BASIN.

DESCRIPTION.

Rogue River drains an area in the southwestern corner of the State of Oregon, including the extreme western part of Klamath County and portions of Jackson, Josephine, and Curry counties. On its north side are the Rogue River Mountains, on the east are the Cascades, and in southern part of the area is a spur of the Siskiyou Mountains. In all, the basin comprises 5,080 square miles.

The river is formed by three principal forks—the North, Middle, and South—which rise among the peaks of the Cascade Range and unite near Prospect, in Jackson County. From this point Rogue River winds in a general westerly direction to the ocean, which it enters near the town of Gold Beach, in Curry County. In the lower half of its course the stream hugs closely the base of the Rogue River Range. Its principal tributaries are shown by the following table:

Principal tributaries of Rogue River.

From the north and west.	From the east and south.
North Fork.	Middle Fork.
Elk Creek.	South Fork.
Stewarts Creek.	Big Butte Creek (drainage area, 268 square miles).
Evans Creek.	Little Butte Creek (drainage area, 361 square miles).
Leland Creek.	Bear Creek (Stewarts Creek) (drainage area, 380 square miles).
	Applegate Creek (drainage area, 606 square miles).
	Illinois River.

The North Fork, or main stream, derives its water from springs, probably supplied from Crater Lake, which lies near the center of Crater Lake National Park, at an elevation of 6,240 feet above sea level. This lake occupies the crater of an ancient volcanic mountain, to which the name Mount Mazama has been applied. The lake has no visible outlet.[1] The walls inclosing it are made up of alternating

[1] Diller, J. S., Geology of Crater Lake National Park: Prof. Paper U. S. Geol. Survey No. 3, 1902, p. 60.

sheets of lava, dipping away from the lake practically in all directions. They are porous enough to afford passage for considerable water. Springs around the base of the mountain are abundant. Little and Big Butte creeks drain the southern portion of the Crater Lake National Forest. Bear Creek, formerly called Stewart Creek, drains the famous fruit section of the Rogue River valley; Applegate Creek drains the Siskiyou Mountains; and Illinois River drains the territory to the south of the main stream near the coast, a portion of which is in the Siskiyou National Forest.

The drainage area is, in general, mountainous, elevations ranging from sea level at Gold Beach to 9,760 feet at the summit of Mount McLaughlin (formerly known as Mount Pitt), a snow-capped peak dividing the drainage of Big Butte and Little Butte creeks. The general elevation of the mountain range at the headwaters of the Rogue is 6,000 feet. Prospect is 3,000 feet, Ashland is 1,938 feet, and Grants Pass 956 feet above sea level.

The area is almost entirely forested. The mean annual rainfall at Gold Beach is 86 inches, at Grants Pass 33, at Ashland 27, on the headwaters of Illinois River 70, and at Crater Lake 100 inches. On the headwaters of the stream a large part of the precipitation during the winter months is in the form of snow. The rainfall is insufficient for the production of crops without irrigation.

Fish Lake ditch, which diverts water from Little Butte Creek, is the largest in operation. A number of little ditches are used to irrigate the narrow valley lands contiguous to the small streams. In this manner Ashland, Wagner, and Applegate creeks are largely appropriated for irrigation. It is realized that the agricultural resources of this section of the country will not be utilized in the most economic manner until irrigation is practiced extensively. The valley lands in the vicinity of Grants Pass along Bear Creek are particularly adapted to fruit culture, and the Rogue River valley has become justly famous for the excellent quality of its apples, pears, and other fruits.

The streams of this area, like others draining the Cascade Mountains, afford wonderful opportunities for water-power development. At present the only important plants are those of the Rogue River Electric Co. at Gold Hill and at Prospect.

Stream measurements in this basin were begun in August, 1905. For the four years the highest run-off values are shown by the records for 1907. It is probable that the lowest values would have been found in 1905 if records for that year had been complete.

NORTH FORK OF ROGUE RIVER AT PROSPECT, OREG.

This station was established July 17, 1907, just above the Rogue River Electric Co.'s dam, half a mile above Prospect, 5 miles above

the junction with the South Fork, and at the head of Rogue River gorge. Gage readings are furnished by the Rogue River Electric Co.

The fall of the river through this gorge is to be utilized for development of water power. The data are valuable chiefly in connection with water-power development, but they furnish also some very useful information concerning the run-off from forested areas under the climatic conditions which exist in the southern portion of the Cascade Range.

No equipment has yet been installed for making measurements during high water, and at low water the only point available is in a very narrow canyon where the water is extremely turbulent and the velocities are most irregular.

During 1907 a vertical staff gage was used, located about 250 feet above the dam. Daily readings during 1908 and 1909 were made from a staff gage at the observer's house below the dam. This gage was washed out on November 23, 1909, and replaced by the observer December 20, 1909.

No discharge measurements were made during 1909.

A rating curve has not yet been developed for this station.

Daily gage height, in feet, of North Fork of Rogue River at Prospect, Oreg., for 1909.

[E. F. Graham, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.0	2.0	2.2	2.1	2.5	2.8	1.7	1.4	1.5	1.8	2.0	.....
2	2.0	2.0	2.2	2.2	2.6	2.9	1.7	1.5	1.5	1.8	2.0	.....
3	2.1	2.0	2.1	2.2	2.8	2.9	1.6	1.5	1.5	1.8	1.9	.....
4	2.2	2.0	2.1	2.1	2.8	2.9	1.6	1.6	1.5	1.7	1.9	.....
5	2.5	2.1	2.0	2.1	2.7	2.8	1.7	1.6	1.5	1.7	2.1	.....
6	2.9	2.1	2.0	2.0	2.7	2.7	1.8	1.6	1.5	1.7	1.9	.....
7	2.9	2.1	2.0	2.0	2.7	2.6	2.0	1.7	1.6	1.6	1.8	.....
8	2.8	2.1	2.0	2.0	2.6	2.5	1.9	1.7	1.6	1.6	1.9	.....
9	2.6	2.0	1.9	2.1	2.6	2.4	1.8	1.7	1.6	1.6	1.9	.....
10	2.4	1.9	1.8	2.1	2.6	2.4	1.8	1.7	1.6	1.6	2.0	2.2
11	2.0	1.9	1.8	2.1	2.5	2.3	1.7	1.7	1.6	1.7	2.1	2.3
12	2.0	1.9	1.9	2.1	2.5	2.3	1.7	1.7	1.6	1.7	2.2	2.8
13	2.1	1.8	1.9	2.2	2.4	2.3	1.7	1.6	1.7	1.7	2.1	2.9
14	2.2	1.9	2.0	2.2	2.2	2.3	1.6	1.6	1.7	1.7	2.0	2.6
15	2.4	2.0	2.1	2.2	2.1	2.2	1.6	1.6	1.7	1.8	1.8	2.4
16	3.8	2.5	2.1	2.1	2.1	2.2	1.6	1.6	1.7	1.8	1.7	2.3
17	3.6	3.0	2.2	2.1	2.1	2.2	1.6	1.6	1.6	1.7	1.7	2.1
18	3.4	2.8	2.2	2.1	2.1	2.1	1.6	1.7	1.6	1.6	1.7	2.0
19	3.9	2.5	2.2	2.2	2.1	2.1	1.5	1.7	1.6	1.6	2.4	2.0
20	4.5	2.4	2.2	2.2	2.0	2.0	1.5	1.6	1.6	1.7	5.2	2.0
21	4.9	2.2	2.1	2.2	2.0	2.0	1.5	1.6	1.6	1.8	4.0	1.8
22	3.9	2.0	2.0	2.3	2.0	2.0	1.5	1.6	1.7	1.9	7.0	1.8
23	3.0	2.0	2.0	2.3	2.0	1.9	1.4	1.6	1.7	1.8	.....	1.6
24	2.8	2.0	2.0	2.3	2.1	1.9	1.4	1.6	1.7	1.7	.....	1.6
25	2.6	2.1	2.0	2.3	2.1	1.9	1.4	1.6	1.7	1.7	.....	1.8
26	2.5	2.1	2.1	2.4	2.2	1.8	1.4	1.5	1.7	1.6	.....	1.8
27	2.4	2.1	2.1	2.4	2.4	1.8	1.4	1.5	1.7	1.6	.....	1.7
28	2.1	2.1	2.1	2.5	2.5	1.8	1.4	1.5	1.7	1.7	.....	1.6
29	2.1	.....	2.2	2.5	2.6	1.8	1.4	1.5	1.8	1.7	.....	1.5
30	2.0	.....	2.2	2.5	2.6	1.7	1.4	1.5	1.8	1.7	.....	1.4
31	2.0	.....	2.1	.....	2.7	.....	1.4	1.5	.....	1.8	.....	1.4

ROGUE RIVER NEAR TOLO, OREG.

This station, which was established August 30, 1905, is located just below the dam of the Rogue River Electric Co.'s power plant at Gold Ray, Oreg., 1½ miles below Tolo, Oreg., and below the confluence of Bear Creek.

The staff gage is fastened to a pier of the highway bridge about 250 feet below the dam and below the tailrace of the power house. It is about 300 feet upstream from the cable measuring section.

The data obtained at this station are of value in connection with the use of the river for water-power development and its proposed use for extensive irrigation, a number of large canals being already under construction.

The flow at this station is affected by the operation of the power plant. The velocity of the water at the measuring section is swift and the channel rough, and although conditions are apparently permanent it has been impossible to develop a permanent rating curve. The records, particularly those taken at low water, are not as accurate as could be desired.

No discharge measurements were made during 1909. The station was last inspected December 29, 1908, and the accuracy of the daily and monthly discharges given below depends on the permanency of conditions of flow and of the elevation of the gage since that date.

Daily gage height, in feet, of Rogue River near Tolo, Oreg., for 1909.

[F. H. Farrar, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.5	3.15	3.6	2.4	2.7	2.9	1.25	1.2	0.9	1.1	2.4	5.2
2	1.5	2.95	3.4	2.4	2.75	3.1	1.2	1.2	.9	1.1	2.15	4.8
3	1.75	4.25	3.4	2.4	3.05	3.1	1.2	1.1	.9	1.1	1.75	4.15
4	3.4	4.1	3.75	2.5	3.3	3.0	1.3	1.1	.9	1.1	1.5	4.0
5	8.85	4.05	3.55	2.5	3.2	2.8	1.45	1.0	.9	1.1	1.55	3.9
6	6.65	3.65	3.3	2.4	2.95	2.65	1.6	1.0	.9	1.1	1.65	4.0
7	7.8	3.85	3.2	2.45	2.85	2.6	1.75	1.0	.9	1.1	1.6	4.0
8	10.6	3.6	3.1	2.4	2.8	2.45	1.8	1.0	.9	1.1	1.6	4.25
9	5.95	3.65	3.1	2.4	2.8	2.3	1.75	1.0	.9	1.1	1.65	7.05
10	4.5	3.85	3.05	2.4	2.65	2.2	1.65	1.0	.9	1.1	1.9	4.8
11	4.3	3.8	3.0	2.5	2.55	2.2	1.6	1.0	.95	1.05	1.9	4.35
12	3.75	3.75	2.9	2.5	2.4	2.35	1.6	1.0	1.0	1.0	1.8	4.7
13	3.7	4.25	2.7	2.5	2.4	2.15	1.45	1.0	1.0	1.0	1.75	5.05
14	5.35	4.0	2.65	2.5	2.35	1.85	1.4	1.0	1.0	1.0	1.6	4.55
15	7.1	3.95	2.5	2.6	2.4	1.9	1.3	1.0	1.0	1.0	1.5	4.15
16	11.7	4.1	2.5	2.7	2.35	2.2	1.2	1.0	1.0	1.0	1.5	3.8
17	7.75	6.3	2.5	2.7	2.25	2.25	1.2	.9	1.0	1.0	1.5	3.5
18	7.65	5.85	2.55	2.7	2.15	2.2	1.2	.9	1.0	1.0	1.45	3.6
19	7.9	5.85	2.8	2.8	2.1	2.1	1.2	.85	1.1	1.0	2.05	3.25
20	11.25	5.9	2.9	2.8	2.0	2.1	1.2	.8	1.1	1.0	10.35	3.1
21	10.5	5.0	2.85	2.6	1.95	2.1	1.3	.8	1.1	1.0	8.5	2.95
22	9.0	4.3	2.8	2.55	1.9	2.1	1.3	.8	1.0	1.0	10.6	2.85
23	6.5	4.0	2.6	2.5	1.85	2.05	1.3	.8	1.0	1.0	17.0	2.65
24	5.45	4.35	2.6	2.5	1.9	1.95	1.2	.9	1.0	1.0	11.25	2.5
25	5.0	4.45	2.6	2.6	1.95	1.85	1.25	.9	1.0	1.0	7.8	2.45
26	4.4	4.15	2.45	2.55	2.05	1.75	1.35	.9	1.1	1.0	5.85	2.3
27	4.05	3.9	2.4	2.55	2.2	1.7	1.3	.9	1.1	1.0	5.15	2.3
28	3.75	3.8	2.4	3.0	2.9	1.65	1.25	.9	1.1	1.05	4.9	2.3
29	3.6	.....	2.4	2.95	2.75	1.55	1.2	.9	1.1	1.1	4.55	2.3
30	3.65	.....	2.45	2.9	2.65	1.45	1.2	.9	1.1	1.15	6.35	2.25
31	3.5	.....	2.4	.....	2.7	.....	1.2	.9	.....	1.25	.....	3.35

Daily discharge, in second-feet, of Rogue River near Tolo, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,920	4,280	5,160	3,040	3,510	3,830	1,700	1,650	1,400	1,560	3,040	9,080
2	1,920	3,920	4,750	3,040	3,590	4,180	1,650	1,650	1,400	1,560	2,700	8,010
3	2,200	6,630	4,750	3,040	4,090	4,180	1,650	1,560	1,400	1,560	2,200	6,400
4	4,750	6,280	5,490	3,190	4,560	4,000	1,740	1,560	1,400	1,560	1,920	6,050
5	20,000	6,160	5,060	3,190	4,370	3,670	1,880	1,480	1,400	1,560	1,980	5,820
6	13,200	5,270	4,560	3,040	3,920	3,430	2,030	1,480	1,400	1,560	2,080	6,050
7	16,700	5,710	4,370	3,120	3,750	3,350	2,200	1,480	1,400	1,560	2,030	6,050
8	25,900	5,160	4,180	3,040	3,670	3,120	2,260	1,480	1,400	1,560	2,030	6,630
9	11,200	5,270	4,180	3,040	3,670	2,900	2,200	1,480	1,400	1,560	2,080	14,400
10	7,230	5,710	4,090	3,040	3,430	2,760	2,080	1,480	1,400	1,560	2,380	8,010
11	6,750	5,600	4,000	3,190	3,270	2,760	2,030	1,480	1,440	1,520	2,380	6,870
12	5,490	5,490	3,830	3,190	3,040	2,970	2,030	1,480	1,480	1,480	2,260	7,750
13	5,380	6,630	3,510	3,190	3,040	2,700	1,880	1,480	1,480	1,480	2,200	8,680
14	9,480	6,050	3,430	3,190	2,970	2,320	1,830	1,480	1,480	1,480	2,030	7,360
15	14,600	5,940	3,190	3,350	3,040	2,380	1,740	1,480	1,480	1,480	1,920	6,400
16	29,800	6,280	3,190	3,510	2,970	2,760	1,650	1,480	1,480	1,480	1,920	5,600
17	16,500	12,200	3,190	3,510	2,830	2,830	1,650	1,400	1,480	1,480	1,920	4,950
18	16,200	10,900	3,270	3,510	2,700	2,760	1,650	1,400	1,480	1,480	1,880	5,160
19	17,000	10,900	3,670	3,670	2,630	2,630	1,650	1,360	1,560	1,480	2,560	4,460
20	28,200	11,000	3,830	3,670	2,500	2,630	1,650	1,320	1,560	1,480	25,000	4,180
21	25,600	8,540	3,750	3,350	2,440	2,630	1,740	1,320	1,560	1,480	18,900	3,910
22	20,500	6,750	3,670	3,270	2,380	2,630	1,740	1,320	1,480	1,480	25,900	3,740
23	12,800	6,050	3,350	3,190	2,320	2,560	1,740	1,320	1,480	1,480	48,300	3,400
24	9,760	6,870	3,350	3,190	2,380	2,440	1,650	1,400	1,480	1,480	28,200	3,150
25	8,540	7,110	3,350	3,350	2,440	2,320	1,700	1,400	1,480	1,480	16,700	3,080
26	6,990	6,400	3,120	3,270	2,560	2,200	1,780	1,400	1,560	1,480	10,900	2,850
27	6,160	5,820	3,040	3,270	2,760	2,140	1,740	1,400	1,560	1,480	8,940	2,850
28	5,490	5,600	3,040	4,000	3,830	2,080	1,700	1,400	1,560	1,520	8,270	2,850
29	5,160	.....	3,040	3,920	3,590	1,980	1,650	1,400	1,560	1,560	7,360	2,850
30	5,270	.....	3,120	3,830	3,430	1,880	1,650	1,400	1,560	1,600	12,300	2,780
31	4,950	.....	3,040	.....	3,510	.....	1,650	1,400	.....	1,700	.....	4,660

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1, to Nov. 23, not well defined. Curve for 1906 used above 7,230 second-feet. Nov. 24 to Dec. 31, well defined between 1,270 and 6,050 second-feet.

Monthly discharge of Rogue River near Tolo, Oreg., for 1909.

[Drainage area, 2,020 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	29,800	1,920	11,800	5.84	6.73	726,000	C.
February	11,000	3,920	6,730	3.33	3.47	374,000	C.
March	5,490	3,040	3,790	1.88	2.17	233,000	C.
April	4,000	3,040	3,310	1.64	1.83	197,000	C.
May	4,560	2,320	3,200	1.58	1.82	197,000	C.
June	4,180	1,880	2,830	1.40	1.56	168,000	C.
July	2,260	1,650	1,800	.891	1.03	111,000	D.
August	1,650	1,320	1,450	.718	.83	89,200	D.
September	1,560	1,400	1,470	.728	.81	87,500	D.
October	1,700	1,480	1,520	.752	.87	93,500	D.
November	48,300	1,880	8,410	4.16	4.64	500,000	C.
December	14,400	2,780	5,620	2.78	3.20	345,000	C.
The year	48,300	1,320	4,330	2.14	28.96	3,120,000	

LITTLE BUTTE CREEK NEAR EAGLE POINT, OREG.

Little Butte Creek is formed near Lake Creek in Jackson County, by the union of its North and South forks, the united waters flowing westward and joining Rogue River about 3 miles east of Table Rock.

This stream is used to a large extent for irrigation, and additional developments are under way. It also furnishes a water supply for the city of Medford. It is practically the only available source of water for complete irrigation of the upper Rogue River valley. This valley is drained directly by Bear Creek, and comprises about 60,000 acres of agricultural land, nearly all of which is susceptible of intensive agriculture. Fine fruits constitute the most remunerative product of the farm, and this valley has become justly famous for the excellent quality of its apples and pears.

The gaging station was established July 13, 1907. It is located at Tronson & Guthrie's fruit ranch, 1 mile above Eagle Point, about 2 miles above the mouth of Antelope Creek, and above the head of a ditch which diverts water for milling at Eagle Point.

A number of small ditches divert water from the stream above the station, so that the flow here obtained does not wholly represent the natural run-off from the drainage area.

The following discharge measurement was made by A. P. Stover:

September 17, 1909: Gage height, 0.75 feet; discharge, 37.1 second-feet.

Daily gage height, in feet, of Little Butte Creek near Eagle Point, Oreg., for 1909.

[Tronson & Guthrie, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.45	1.9	2.9	1.8	1.5	1.4	1.0	0.8	0.85	1.30	1.40	3.12
2	1.4	1.9	3.1	1.8	1.5	1.4	1.0	.8	.85	1.3	1.3	2.85
3	1.45	4.25	2.6	1.92	1.5	1.35	1.0	.8	.85	1.3	1.25	2.8
4	1.65	3.45	2.3	1.8	1.5	1.35	1.0	.8	.85	1.3	1.2	2.7
5	7.1	2.6	2.3	1.75	1.5	1.45	.95	.8	.85	1.25	1.2	2.55
6	3.7	2.2	2.3	1.75	1.5	1.35	.95	.8	.85	1.25	1.2	2.75
7	4.2	3.15	2.25	1.75	1.5	1.3	.95	.8	.85	1.25	1.2	2.95
8	6.0	3.5	2.2	1.75	1.5	1.3	.95	.8	.85	1.2	1.2	4.15
9	4.75	3.1	2.2	1.7	1.5	1.3	.95	.8	.85	1.2	1.2	2.85
10	3.6	2.9	2.18	1.7	1.5	1.3	.95	.8	.85	1.2	1.2	2.8
11	2.62	2.6	2.15	1.7	1.5	1.3	.9	.8	.85	1.2	1.2	2.85
12	2.10	2.5	2.15	1.7	1.5	1.3	.85	.8	.85	1.2	1.2	3.45
13	1.85	2.5	2.15	1.7	1.5	1.25	.85	.8	1.0	1.2	1.32	2.95
14	6.8	2.4	2.15	1.65	1.7	1.25	.85	.8	.85	1.2	1.3	2.62
15	7.0	2.4	2.15	1.6	1.65	1.25	.85	.8	.85	1.2	1.25	2.5
16	5.4	3.75	2.1	1.6	1.62	1.25	.85	.8	.85	1.2	1.25	2.3
17	5.25	3.0	2.1	1.7	1.6	1.2	.85	.8	.85	1.2	1.32	2.3
18	4.45	4.3	2.08	1.68	1.58	1.2	.85	.8	.85	1.2	2.25	2.2
19	4.7	2.95	2.05	1.65	1.55	1.2	.85	.8	.85	1.2	3.0	2.2
20	6.83	3.3	2.05	1.62	1.5	1.2	.85	.8	.85	1.2	5.35	2.1
21	5.25	3.3	2.05	1.6	1.5	1.15	.85	.8	.85	1.2	4.85	1.98
22	5.1	3.0	2.02	1.6	1.5	1.15	.85	.8	.85	1.2	6.4	1.82
23	3.85	2.7	2.0	1.6	1.45	1.15	.85	.8	.85	1.2	7.65	1.72
24	3.2	2.6	1.98	1.55	1.45	1.15	.85	.8	.85	1.2	5.85	1.6
25	2.9	2.45	1.95	1.55	1.45	1.15	.85	.8	.95	1.2	4.52	1.6
26	2.5	2.4	1.95	1.55	1.45	1.1	.85	.8	.95	1.2	3.3	1.58
27	2.35	2.35	1.9	1.55	1.45	1.1	.85	.8	.95	1.25	2.8	1.55
28	2.1	2.8	1.9	1.55	1.42	1.1	.8	.8	.95	1.25	2.78	1.55
29	2.0	.....	1.85	1.5	1.4	1.0	.8	.8	1.2	1.25	3.3	1.55
30	2.0	.....	1.85	1.5	1.4	1.0	.8	.8	1.2	1.25	4.65	2.05
31	1.9	.....	1.8	.....	1.4	.....	.8	.85	.....	1.42	.....	1.88

Daily discharge, in second-feet, of Little Butte Creek near Eagle Point, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	149	283	763	251	162	136	58	36	41	113	136	810
2	136	283	800	251	162	136	58	36	41	113	113	680
3	149	1,450	564	290	162	124	58	36	41	113	102	656
4	205	975	428	251	162	124	58	36	41	113	92	610
5	3,450	564	428	236	162	149	52	36	41	102	92	541
6	1,120	388	428	236	162	124	52	36	41	102	92	633
7	1,420	825	408	236	162	113	52	36	41	102	92	726
8	2,620	1,000	388	236	162	113	52	36	41	92	92	1,390
9	1,760	800	388	220	162	113	52	36	41	92	92	680
10	1,060	703	381	220	162	113	52	36	41	92	92	656
11	573	564	370	220	162	113	46	36	41	92	92	680
12	351	518	370	220	162	113	41	36	41	92	92	975
13	267	518	370	220	162	102	41	36	58	92	118	726
14	3,220	473	370	205	220	102	41	36	41	92	113	573
15	3,370	473	370	190	205	102	41	36	41	92	102	518
16	2,200	1,150	351	190	196	102	41	36	41	92	102	428
17	2,100	750	351	220	190	92	41	36	41	92	118	428
18	1,570	1,480	344	214	184	92	41	36	41	92	408	388
19	1,730	726	334	205	176	92	41	36	41	92	750	388
20	3,240	900	334	196	162	92	41	36	41	92	2,160	351
21	2,100	900	334	190	162	83	41	36	41	92	1,830	309
22	1,900	750	323	190	162	83	41	36	41	92	2,920	257
23	1,210	610	316	190	149	83	41	36	41	92	3,890	226
24	850	564	309	176	149	83	41	36	41	92	2,520	190
25	703	496	300	176	149	83	41	36	52	92	1,610	190
26	518	473	300	176	149	74	41	36	52	92	900	184
27	450	450	283	176	149	74	41	36	52	102	656	176
28	351	656	283	176	141	74	36	36	52	102	647	176
29	316	.....	267	162	136	58	36	36	92	102	900	176
30	316	.....	267	162	136	58	36	36	92	102	1,700	334
31	283	.....	251	.....	136	.....	36	41	.....	141	.....	277

NOTE.—These discharges are based on a rating curve that is well defined between discharges 28 and 388 second-feet.

Monthly discharge of Little Butte Creek near Eagle Point, Oreg., for 1909.

[Drainage area, 269 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	3,450	136	1,280	4.76	5.49	78,700	C.
February	1,480	283	704	2.62	2.73	39,100	B.
March	800	251	378	1.41	1.63	23,200	A.
April	290	162	209	.777	.87	12,400	A.
May	220	136	163	.606	.70	10,000	A.
June	149	58	100	.370	.41	5,950	B.
July	58	36	44.8	.167	.19	2,750	C.
August	41	36	36.2	.135	.16	2,230	C.
September	92	41	46.4	.172	.19	2,760	C.
October	141	92	98.5	.366	.42	6,060	B.
November	3,890	92	754	2.80	3.12	44,900	C.
December	1,390	176	495	1.84	2.12	30,400	B.
The year	3,890	36	359	1.34	18.03	258,000	

BEAR CREEK AT TALENT, OREG.

Bear Creek, formerly known as Stewart Creek, rises in the southeastern part of Jackson County, and flows northwestward to its junction with Rogue River near Tolo. Its entire drainage area comprises 380 square miles.

The gaging station was established July 11, 1907, at a county highway bridge at Talent, Oreg., 500 feet above the head of a power and irrigation canal which diverts water from the left bank, about half a mile below the mouth of Wagner Creek and 1½ miles above the mouth of Anderson Creek. The vertical staff gage is attached to the bridge from which discharge measurements are made.

The stream is used largely for irrigation, and the data obtained at this station are useful in that connection. Any increase of irrigation development from this stream will require the construction of storage reservoirs.

The conditions are not favorable for good results. The bed of the stream is somewhat changeable, and without a large number of gagings each year only the merest approximation to actual discharges can be secured. No discharge measurements were made during 1909.

Daily gage height, in feet, of Bear Creek at Talent, Oreg., for 1909.

[Clarence Jeffery, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	4.5	4.7	4.55	4.3	4.25	3.7	3.3	3.3	3.4	3.85	4.5
2	3.2	4.65	4.65	4.4	4.4	4.2	3.7	3.3	3.3	3.4	3.75	4.3
3	3.4	5.8	4.7	4.55	4.45	4.2	3.7	3.3	3.3	3.4	3.7	4.25
4	3.4	4.1	4.75	4.4	4.35	4.2	3.7	3.3	3.25	3.4	3.6	4.2
5	3.45	5.0	4.75	4.4	4.3	4.25	3.75	3.3	3.2	3.4	3.6	4.2
6	5.4	4.9	4.85	4.4	4.2	4.2	3.8	3.3	3.2	3.4	3.6	4.25
7	5.75	4.85	4.85	4.35	4.2	4.15	3.8	3.3	3.2	3.4	3.6	4.2
8	5.95	4.8	4.85	4.3	4.25	4.15	3.8	3.3	3.2	3.4	3.6	4.9
9	4.5	4.7	4.8	4.4	4.3	4.15	3.75	3.3	3.2	3.4	3.6	5.4
10	4.1	4.7	4.7	4.4	4.25	4.1	3.7	3.3	3.3	3.4	3.6	5.0
11	4.0	4.8	4.6	4.4	4.2	4.5	3.7	3.3	3.3	3.4	3.55	4.5
12	3.7	5.1	4.5	4.35	4.2	4.0	3.7	3.3	3.25	3.4	3.55	4.6
13	3.7	5.0	4.45	4.35	4.2	4.0	3.65	3.3	3.25	3.4	3.6	4.7
14	7.2	4.8	4.4	4.35	4.15	4.0	3.65	3.3	3.25	3.4	3.65	4.55
15	5.2	4.85	4.4	4.35	4.25	4.0	3.6	3.3	3.25	3.4	3.6	4.4
16	6.0	5.0	4.4	4.35	4.2	4.1	3.6	3.3	3.2	3.4	3.6	4.4
17	6.3	5.9	4.5	4.4	4.15	4.1	3.6	3.25	3.2	3.4	3.6	4.3
18	5.1	5.75	4.5	4.4	4.15	4.5	3.55	3.25	3.2	3.45	3.75	4.2
19	5.7	5.4	4.5	4.4	4.15	4.0	3.5	3.2	3.2	3.5	3.85	4.2
20	5.4	5.3	4.5	4.4	4.1	4.0	3.5	3.2	3.2	3.5	5.1	4.2
21	6.9	5.1	4.4	4.4	4.1	4.0	3.5	3.2	3.2	3.5	5.1	4.15
22	6.0	4.95	4.5	4.35	4.1	4.0	3.45	3.2	3.2	3.5	5.1	4.1
23	5.4	4.9	4.4	4.3	4.5	3.95	3.4	3.2	3.2	3.5	5.72	4.0
24	5.0	5.0	4.4	4.3	4.5	3.9	3.4	3.35	3.15	3.45	5.1	4.0
25	4.9	4.85	4.5	4.25	4.0	3.85	3.4	3.2	3.35	3.45	4.5	4.0
26	4.8	4.85	4.4	4.4	4.0	3.8	3.4	3.2	3.45	3.45	4.5	4.0
27	4.7	4.8	4.4	4.3	4.15	3.75	3.4	3.2	3.4	3.45	4.4	4.0
28	4.6	4.8	4.4	4.3	4.4	3.8	3.35	3.2	3.35	3.45	4.5	4.0
29	4.5	.....	4.5	4.3	4.3	3.75	3.3	3.15	3.35	3.4	4.75	4.0
30	4.5	.....	4.5	4.25	4.2	3.75	3.3	3.2	3.4	3.4	4.75	4.2
31	4.5	.....	4.5	.....	4.3	.....	3.3	3.25	.....	3.85	.....	4.5

APPLEGATE CREEK AT MURPHY, OREG.

Applegate Creek rises in the Siskiyou Mountains in the northwestern part of Siskiyou County, Cal., flows northeastward into Jackson County, Oreg., for about 20 miles, then turns to the northwest and unites with Rogue River about 8 miles west of Grants Pass in Josephine County. Its drainage area comprises 606 square miles.

The gaging station was established July 22, 1907, at a county highway bridge at Murphy, Oreg., 8 miles above the mouth of the creek and 7 miles from Grants Pass.

The vertical staff gage is on the right bank 250 feet below the bridge from which discharge measurements are made. The gage datum has remained the same.

The data obtained at this station are needed in connection with the use of the stream for irrigation, mining, and the development of water power. Small ditches are numerous in the vicinity of the station, but most of them serve only a single farm. It has been observed that since early irrigation has been practiced the summer flow of the stream at this point is more uniformly maintained than before.

The conditions at the station are not favorable for very good results. The height of the water is affected in an irregular manner by a brush dam about 600 feet below the gage. It is washed away, either wholly or in part, with every rise in the creek, even during irrigating seasons.

No discharge measurements were made during 1909, and estimates of discharge are withheld until more data have been obtained.

Daily gage height, in feet, of Applegate Creek at Murphy, Oreg., for 1909.

[James W. Gilmore, observer.]

Day.	Jan.	Feb.	Mar	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.79	5.95	6.25	5.3	5.45	5.54	4.78	4.6	4.8	5.15	6.0	6.1
2	4.8	6.3	6.1	5.3	5.6	5.56	4.77	4.6	4.8	5.05	5.4	6.1
3	5.02	6.7	6.0	5.32	5.63	5.58	4.75	4.6	4.78	5.05	5.2	5.9
4	5.04	6.4	6.1	5.3	5.65	5.7	4.72	4.6	4.78	5.05	5.1	5.9
5	7.35	6.35	6.0	5.3	5.7	5.7	4.7	4.6	4.8	5.05	5.1	5.9
6	6.7	6.35	5.95	5.28	5.6	5.68	4.7	4.6	4.8	5.05	5.1	6.0
7	7.9	6.25	5.8	5.26	5.6	5.56	4.7	4.6	4.8	5.05	5.05	6.2
8	8.0	6.02	5.75	5.24	5.58	5.5	4.7	4.6	4.8	5.05	5.1	6.5
9	6.9	6.3	5.7	5.28	5.58	5.4	4.7	4.6	4.8	5.05	5.1	7.4
10	6.2	6.15	5.6	5.32	5.5	5.4	4.68	4.6	4.8	5.05	5.05	6.9
11	6.0	6.1	5.5	5.32	5.45	5.4	4.68	4.55	4.82	5.05	5.0	6.5
12	5.75	6.12	5.5	5.32	5.4	5.4	4.75	4.55	4.82	5.05	5.0	6.45
13	5.6	6.5	5.5	5.32	5.35	5.3	4.75	4.5	4.82	5.05	5.0	6.4
14	8.25	6.35	5.5	5.36	5.32	5.3	4.8	4.5	4.82	5.05	5.0	6.35
15	7.9	6.4	5.52	5.4	5.38	5.3	4.86	4.5	4.82	5.05	5.0	6.3
16	8.2	7.15	5.55	5.5	5.32	5.3	4.75	4.5	4.82	5.05	5.0	6.2
17	8.6	7.5	5.57	5.65	5.3	5.28	4.7	4.55	4.82	5.05	5.0	6.1
18	7.8	7.52	5.62	5.6	5.3	5.25	4.7	4.6	4.82	5.05	5.1	6.0
19	8.7	7.3	5.57	5.5	5.3	5.22	4.7	4.65	4.82	5.0	6.4	5.9
20	11.0	7.0	5.52	5.46	5.28	5.2	4.68	4.7	4.82	4.9	8.75	5.85
21	10.75	6.75	5.5	5.44	5.28	5.15	4.64	4.7	4.82	4.85	8.0	5.8
22	8.7	6.5	5.46	5.42	5.26	5.1	4.6	4.75	4.82	4.8	7.8	5.75
23	7.5	6.3	5.43	5.37	5.25	5.05	4.6	4.75	4.82	4.8	11.95	5.7
24	7.0	6.75	5.4	5.35	5.25	5.02	4.6	4.8	4.82	4.8	9.0	5.6
25	6.75	6.5	5.37	5.35	5.3	5.02	4.58	4.8	4.82	4.8	7.5	5.6
26	6.45	6.4	5.37	5.35	5.4	5.02	4.55	4.8	4.82	4.8	6.9	5.65
27	6.3	6.4	5.35	5.4	5.55	4.9	4.55	4.78	4.85	4.8	6.6	5.7
28	6.15	6.32	5.35	5.55	5.45	4.9	4.57	4.78	4.9	4.84	6.3	5.75
29	6.0	.....	5.38	5.5	5.38	4.85	4.6	4.78	4.95	4.85	6.25	5.8
30	6.0	.....	5.35	5.45	5.32	4.8	4.6	4.76	4.98	4.9	6.2	5.85
31	5.98	.....	5.3	.....	5.5	.....	4.6	4.78	.....	6.4	.....	6.1

UMPQUA RIVER DRAINAGE BASIN.

DESCRIPTION.

Umpqua River is formed by the junction of its North and South forks near the city of Roseburg, in Douglas County, Oreg. The North Fork rises in Diamond Lake on the summit of the Cascade Mountains at an elevation of 5,300 feet and flows westward. The South Fork is also formed by two forks—the northern rises in Old Bailey Mountain about 4 miles south of Diamond Lake, and the southern on the northern slope of Abbot Butte and flows westward and northward. From the junction of its principal forks, Umpqua River takes a tortuous but in general northerly course to Elkton, beyond which its course is more nearly west until it empties into the Pacific Ocean at Winchester Bay, in the northwestern part of Douglas County. Its total drainage area comprises about 4,000 square miles. At Scottsburg, just above tidewater, the area measures 3,070 square miles. The North Umpqua drains 1,080 and the South Umpqua 1,990 square miles. The important tributaries of the Umpqua are Smiths River, which drains the low mountainous area near the coast; Elk Creek, which drains the divide between the Umpqua and Willamette basins; Cow Creek, which drains the divide between Rogue River and the Umpqua drainage basin; and the North and South forks.

The country is rough and mountainous, and the streams flow in comparatively narrow valleys bordered by narrow stretches of agricultural land. The general elevation of the headwaters is 6,000 feet, with a few snow-capped peaks 8,000 to 10,000 feet high. As the elevation at Roseburg is 485 feet above sea level, it is apparent that the North Fork falls nearly 3,800 feet in the 75 miles from Diamond Lake to Roseburg by the river channel. The lower portion of the Umpqua has comparatively little fall, as is evidenced by the very winding character of the stream.

The region is one of the most densely forested in the United States, and probably 80 per cent of the drainage area can be classed as heavily forested. About one-fourth of the forest area is included in the national forests; the rest is owned by corporations and individuals.

The mean annual rainfall at Roseburg is 30 inches; at Drain, near the divide between the Willamette and Umpqua drainage basins, it is 48 inches. The mouth of the stream probably receives as much as 60 inches per annum, while at the headwaters the precipitation is 100 inches or more. Except on the headwaters, all of this falls as rain during the nine months of the year from September to May.

Little or no irrigation has been practiced in the Umpqua Valley, although a few small ditches take water from the smaller creeks

tributary to the North and South forks. The agricultural products consist of grain and fruits. For the production of apples, prunes, and similar fruits, the climate and soil are especially well adapted. Although the opportunities for water-power development in this area are almost phenomenal, there are no plants of importance.

SOUTH FORK OF UMPQUA RIVER NEAR BROCKWAY, OREG.

This station, which was established December 6, 1905, is located just below Winston's highway bridge, 6 miles south of Roseburg and 3 miles east of Brockway, Oreg., 3 miles below the mouth of Lookingglass Creek, 10 miles below the mouth of Myrtle Creek, and 7 miles above the confluence of the North and South forks of Umpqua River.

The data obtained at this station are of particular interest in studying the run-off from forested areas and are of practical use for economic development of the water resources of this region.

The staff gage consists of an inclined low-water section, on the right bank, and a vertical high-water section, originally located at the cable section about 300 feet below the highway bridge, to which it was transferred January 14, 1907.

Discharge measurements were originally made from a cable, but this was destroyed by flood January 4, 1907. Since this date the highway bridge has been used. The gage datum has remained unchanged.

The conditions at this station are favorable for good results, and a permanent rating curve has been established. There is never any ice at this station. No discharge measurements were made in 1909.

Daily gage height, in feet, of South Fork of Umpqua River near Brockway, Oreg., for 1909.

[Geo. Brosi, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.55	5.05	6.1	3.4	2.3	2.6	0.7	0.2	.....	0.3	3.9	7.1
2	3.7	5.15	5.65	3.35	2.25	2.5	.65	.2	.....	.5	3.7	6.25
3	4.4	9.2	5.45	3.3	2.25	2.45	.6	.2	.....	.6	2.95	5.4
4	6.9	7.8	5.45	3.25	2.5	2.3	.6	.15	.....	.6	2.7	5.15
5	7.95	6.9	5.4	3.25	2.45	2.15	.55	.15	.....	.55	2.55	4.2
6	10.0	6.55	5.2	3.15	2.3	2.0	.65	.15	.....	.4	2.3	4.3
7	12.1	6.25	4.9	3.05	2.2	1.8	1.0	.15	.....	.35	2.25	4.5
8	12.2	5.9	4.9	2.9	2.1	1.65	1.0	.15	.....	.3	2.2	5.6
9	9.3	5.65	4.9	2.85	2.05	1.55	.9	.1	.....	.3	2.35	11.3
10	6.9	6.25	4.9	2.8	2.0	1.45	.8	.1	.....	.25	3.4	9.25
11	5.95	5.9	4.75	2.8	2.0	1.4	.7	.1	.....	.25	3.4	7.9
12	5.1	5.75	4.35	2.8	2.0	1.35	.65	.1	.....	.2	3.2	7.3
13	4.75	6.95	4.1	2.75	1.95	1.3	.6	.1	.....	.2	2.9	9.1
14	5.05	6.9	4.0	2.7	1.9	1.3	.6	.1	.....	.15	2.8	7.6
15	10.9	6.75	3.95	2.65	1.85	1.25	.55	.1	.....	.1	2.75	6.85
16	18.7	6.75	3.95	2.65	1.8	1.35	.5	.1	.....	.1	2.5	6.18
17	11.15	9.3	3.95	2.6	1.8	1.4	.45	.1	.....	.1	2.35	5.75
18	12.1	8.0	3.9	2.6	1.75	1.35	.4	.05	.....	.15	2.25	4.65
19	9.9	8.5	3.8	2.55	1.75	1.3	.4	.05	.....	.35	2.5	4.3
20	13.6	8.25	3.75	2.55	1.65	1.2	.4	.05	.....	.5	7.5	3.9

Daily gage height, in feet, of South Fork of Umpqua River, near Brockway, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	14.65	8.05	3.6	2.5	1.6	1.1	.35	.05	.....	.6	9.0	3.7
22	13.0	7.0	3.45	2.4	1.6	1.05	.35	.05	.....	.8	9.05	3.25
23	9.45	6.3	3.35	2.3	1.55	1.0	.3	.05	.....	.75	24.5	3.2
24	7.5	6.05	3.3	2.25	1.55	.95	.3	.05	.....	.7	15.2	3.15
25	5.15	7.6	3.2	2.2	1.5	.9	.25	.....	.....	.65	10.05	3.1
26	5.2	6.7	3.15	2.15	1.45	.85	.25	.....	.....	.6	7.15	3.0
27	5.1	6.45	3.15	2.05	1.5	.8	.25	.....	.....	.6	7.15	2.9
28	4.8	6.2	3.15	2.15	2.0	.75	.25	.....	.05	.7	6.1	2.6
29	4.6	.....	3.2	2.5	2.3	.75	.25	.....	.1	1.0	6.15	2.25
30	4.65	.....	3.55	2.5	2.55	.7	.25	.....	.2	1.25	7.6	2.35
31	5.0	.....	3.45	.....	2.65	.....	.2	.....	.....	1.7	.....	3.25

NOTE.—The river stage was probably below zero of the gage from Aug. 25 to Sept. 27. The observer recorded the stage as zero during this period.

Daily discharge, in second-feet, of South Fork of Umpqua River near Brockway, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,280	4,750	7,190	2,110	1,140	1,360	354	206	160	232	2,750	9,890
2	2,470	4,960	6,080	2,060	1,100	1,280	338	206	160	290	2,470	7,580
3	3,540	16,200	5,620	2,000	1,100	1,240	321	206	160	321	1,660	5,500
4	9,330	11,900	5,620	1,950	1,280	1,140	321	194	160	321	1,440	4,960
5	12,400	9,330	5,500	1,950	1,240	1,040	306	194	160	306	1,320	3,210
6	18,800	8,380	5,060	1,850	1,140	940	338	194	160	260	1,140	3,370
7	25,600	7,580	4,450	1,750	1,070	820	465	194	160	246	1,100	3,710
8	25,900	6,690	4,450	1,610	1,000	740	465	194	160	232	1,070	5,960
9	16,500	6,080	4,450	1,560	972	692	426	182	160	232	1,180	23,000
10	9,330	7,580	4,450	1,520	940	648	389	182	160	219	2,110	16,400
11	6,820	6,690	4,160	1,520	940	627	354	182	160	219	2,110	12,200
12	4,850	6,320	3,460	1,520	940	606	338	182	160	206	1,900	10,500
13	4,160	9,470	3,050	1,480	910	585	321	182	160	206	1,610	15,900
14	4,750	9,330	2,900	1,440	880	585	321	182	160	194	1,520	11,300
15	21,600	8,920	2,820	1,400	850	564	306	182	160	182	1,480	9,190
16	48,700	8,920	2,820	1,400	820	606	290	182	160	182	1,280	7,400
17	22,500	16,500	2,820	1,360	820	627	275	182	160	182	1,180	6,320
18	25,600	12,500	2,750	1,360	792	606	260	171	160	194	1,100	3,980
19	18,400	14,000	2,610	1,320	792	585	260	171	160	246	1,280	3,370
20	30,600	13,300	2,540	1,320	740	544	260	171	160	290	11,000	2,750
21	34,200	12,700	2,340	1,280	715	504	246	171	160	321	15,600	2,470
22	28,600	9,610	2,160	1,210	715	484	246	171	160	389	15,800	1,950
23	17,000	7,710	2,060	1,140	692	465	232	171	160	372	70,700	1,900
24	11,000	7,060	2,000	1,100	692	446	232	171	160	354	36,100	1,850
25	4,960	11,300	1,900	1,070	670	426	219	160	160	338	18,900	1,800
26	5,060	8,780	1,850	1,040	648	408	219	160	160	321	10,000	1,700
27	4,850	8,100	1,850	972	670	389	219	160	160	321	10,000	1,610
28	4,260	7,450	1,850	1,040	940	372	219	160	171	354	7,190	1,360
29	3,890	.....	1,900	1,280	1,140	372	219	160	182	465	7,320	1,100
30	3,980	.....	2,280	1,280	1,320	354	219	160	206	564	11,300	1,180
31	4,650	.....	2,160	.....	1,400	.....	206	160	.....	765	.....	1,950

NOTE.—These discharges are based on a rating curve that is well defined between 206 and 15,600 second-feet. The discharges for Aug. 25 to Sept. 27 have been taken as 160 second-feet, but it is probable that the daily flow during part of this period was lower.

Monthly discharge of South Fork of Umpqua River near Brockway, Oreg., for 1909.

[Drainage area, 1,800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	48,700	2,280	14,100	7.83	9.03	867,000	B.
February	16,500	4,750	9,360	5.20	5.42	520,000	B.
March	7,190	1,850	3,390	1.88	2.17	208,000	A.
April	2,110	972	1,460	.811	.90	86,900	A.
May	1,400	648	938	.521	.60	57,700	A.
June	1,360	354	668	.371	.41	39,700	A.
July	465	206	296	.164	.19	18,200	A.
August	206	160	179	.099	.11	11,000	B.
September	206	160	163	.091	.10	9,700	C.
October	765	182	301	.167	.19	18,500	B.
November	70,700	1,070	8,120	4.51	5.03	483,000	B.
December	23,000	1,100	5,980	3.32	3.83	368,000	B.
The year	70,700	160	3,750	2.08	27.98	2,690,000	

NOTE.—The mean for September is probably too high, owing to inaccurate gage readings.

UMPQUA RIVER NEAR ELKTON, OREG.

This station, which was established October 18, 1905, by J. G. Kelley, of Portland, through whose cooperation the station is maintained, is located at Smiths Ferry at the falls in the river 4 miles above Elkton, Oreg. No important tributaries are received by the river in the vicinity of the station, the nearest being Elk Creek, 3 miles downstream.

The data obtained here are valuable chiefly in connection with water-power development, but they are also of considerable scientific interest, in that they determine run-off factors for large areas heavily forested and under heavy rainfall.

The inclined gage is 100 feet above the ferry on the left bank. The conditions at the station are favorable for good results. The channel is fairly permanent. The banks are high and do not overflow, although the river is subject to enormous floods. The datum of the gage has not been changed since it was established, but the gage heights have not been observed with any degree of refinement.

No discharge measurements were made during 1909.

Daily gage height, in feet, of Umpqua River near Elkton, Oreg., for 1909.

[D. C. Higginbotham, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	4.5	7.4	3.55	3.2	2.9	0.55	0.15	−0.3	0.8	2.5	9.5
2	6.5	6.5	7.1	3.7	3.05	3.1	.4	.15	.....	.7	4.5	8.0
3	8.5	8.5	7.4	3.55	3.0	2.85	.45	.15	.....	.55	4.0	7.0
4	10.5	11.5	8.1	3.45	3.2	2.55	.6	.15	.....	.4	2.0	6.0
5	12.5	7.5	8.6	3.3	3.4	2.4	.8	.1	.....	.35	1.5	5.5
6	8.5	5.5	7.5	3.3	3.55	2.2	1.1	.1	.....	.25	3.0	4.5
7	13.5	5.5	6.5	3.5	3.6	2.05	1.4	.1	.....	.15	4.0	5.5
8	16.0	7.5	5.1	3.3	3.4	1.85	1.1	.....	.....	.1	5.1	7.5
9	10.5	5.5	5.4	3.2	3.2	2.0	.7	.....	.....	.05	4.5	10.0
10	8.5	5.0	5.25	3.4	2.85	2.3	.55	.....	.....	.....	3.5	12.5
11	6.5	7.5	4.7	3.55	2.55	1.4	.4	.....	.....	.....	2.5	8.5
12	4.5	8.5	4.6	3.45	2.85	1.3	.45	.....	.....	.....	2.0	10.0
13	3.0	5.5	4.5	3.35	3.25	1.6	.6	.....	.....	.....	1.85	8.5
14	6.0	5.5	4.4	3.25	3.6	2.4	.55	.....	.....	.....	1.55	8.5
15	9.0	7.5	4.2	3.4	3.4	2.6	.4	.....	.....	.....	1.4	8.0
16	11.5	11.5	4.05	3.3	3.1	2.4	.35	.....	.....	.....	1.45	7.4
17	13.5	12.5	3.9	3.2	2.85	2.15	.3	.....	.....	.....	1.8	6.75
18	16.0	8.5	3.6	3.1	2.45	1.9	.25	.....	.....	.1	2.4	6.1
19	20.5	8.0	3.45	3.3	2.4	1.6	.25	.....	.....	.1	3.5	5.6
20	26.0	11.5	3.25	3.35	2.05	1.45	.3	.....	.....	.05	11.75	5.1
21	23.5	10.0	3.05	3.15	1.85	1.3	.2	.....	.....	.2	11.5	4.6
22	18.0	8.1	3.4	3.1	1.55	1.05	.3	.....	.....	.45	16.0	4.2
23	13.0	7.6	3.6	3.1	1.4	.95	.45	.....	.....	.6	36.5	4.05
24	11.5	7.35	3.1	3.25	1.2	.7	.4	.....	.....	.3	17.5	3.8
25	10.0	7.9	3.05	3.1	1.0	.55	.25	.....	.....	.1	13.5	3.6
26	9.0	9.1	3.1	3.05	1.1	.7	.2	.....	.....	.05	10.5	3.4
27	7.5	9.6	3.3	3.2	1.4	.9	.2	.....	.1	.0	8.5	3.2
28	5.5	7.9	3.6	3.4	1.2	1.2	.35	.....	.3	.1	7.0	3.4
29	5.0	.....	3.6	3.45	1.65	.9	.25	.....	.45	.4	6.5	4.35
30	3.5	.....	3.35	3.3	2.1	.6	.2	.....	.6	.95	8.5	5.5
31	3.0	.....	3.1	.....	2.55	.....	.15	.....	.....	1.4	.....	6.5

NOTE.—Water below gage and no record obtained Aug. 8 to Aug. 31; Sept. 2 to 26; and Oct. 10 to 17.

Daily discharge, in second-feet, of Umpqua River near Elkton, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8,500	9,880	19,000	7,380	6,540	5,840	1,820	1,420	1,050	2,120	4,960	26,500
2	16,000	16,000	17,900	7,750	6,180	6,300	1,670	1,420	1,080	2,000	9,880	21,000
3	22,800	22,800	19,000	7,380	6,070	5,720	1,720	1,420	1,110	1,820	8,500	17,600
4	30,300	34,100	21,400	7,140	6,540	5,060	1,880	1,420	1,120	1,670	3,980	14,400
5	38,000	19,300	23,200	6,780	7,020	4,760	2,120	1,380	1,110	1,620	3,100	12,800
6	22,800	12,800	19,300	6,780	7,380	4,360	2,500	1,380	1,090	1,520	6,070	9,880
7	41,800	12,800	16,000	7,260	7,500	4,080	2,940	1,380	1,090	1,420	8,500	12,800
8	51,800	19,300	11,600	6,780	7,020	3,710	2,500	1,380	1,090	1,380	11,600	19,300
9	30,300	12,800	12,500	6,540	6,540	3,980	2,000	1,340	1,080	1,340	9,880	28,400
10	22,800	11,300	12,100	7,020	5,720	4,560	1,820	1,300	1,080	1,310	7,260	38,000
11	16,000	19,300	10,400	7,380	5,060	2,940	1,670	1,280	1,090	1,280	4,960	22,800
12	9,880	22,800	10,200	7,140	5,720	2,790	1,720	1,260	1,110	1,250	3,980	28,400
13	6,070	12,800	9,880	6,900	6,660	3,270	1,880	1,240	1,130	1,230	3,710	22,800
14	14,400	12,800	9,600	6,660	7,500	4,760	1,820	1,220	1,140	1,210	3,180	22,800
15	24,600	19,300	9,040	7,020	7,020	5,170	1,670	1,200	1,130	1,200	2,940	21,000
16	34,100	34,100	8,640	6,780	6,300	4,760	1,620	1,180	1,120	1,200	3,020	19,000
17	41,800	38,000	8,250	6,540	5,720	4,260	1,570	1,160	1,080	1,240	3,620	16,800
18	51,800	22,800	7,500	6,300	4,860	3,800	1,520	1,150	1,020	1,380	4,760	14,700
19	70,200	21,000	7,140	6,780	4,760	3,270	1,520	1,140	1,000	1,380	7,260	13,200
20	93,000	34,100	6,660	6,900	4,080	3,020	1,570	1,130	990	1,340	35,000	11,600
21	82,600	28,400	6,180	6,420	3,710	2,790	1,470	1,110	990	1,470	34,100	10,200
22	60,000	21,400	7,020	6,300	3,180	2,440	1,570	1,090	1,000	1,720	51,800	9,040
23	39,900	19,600	7,500	6,300	2,940	2,300	1,720	1,080	1,040	1,880	138,000	8,640
24	34,100	18,800	6,300	6,660	2,640	2,000	1,670	1,070	1,140	1,570	58,000	8,000
25	28,400	20,700	6,180	6,300	2,370	1,820	1,520	1,050	1,280	1,380	41,800	7,500
26	24,600	25,000	6,300	6,180	2,500	2,000	1,470	1,050	1,320	1,340	30,300	7,020
27	19,300	26,900	6,780	6,540	2,940	2,240	1,470	1,050	1,380	1,290	22,800	6,540
28	12,800	20,700	7,500	7,020	2,640	2,640	1,620	1,050	1,570	1,380	17,600	7,020
29	11,300	.....	7,500	7,140	3,360	2,240	1,520	1,050	1,720	1,670	16,000	9,460
30	7,260	.....	6,900	6,780	4,170	1,880	1,470	1,050	1,880	2,300	22,800	12,800
31	6,070	.....	6,300	.....	5,060	.....	1,420	1,050	.....	2,940	.....	16,000

NOTE.—These discharges are based on a rating curve that is well defined between 1,100 and 13,000 second-feet. The rating table above 8,500 second-feet is the same as that published in Water-Supply Paper No. 252, p. 52. Discharges Aug. 8 to 31, Sept. 2 to 26, and Oct. 10 to 17 are estimates, based on comparisons of hydrographs for other stations in Umpqua River basin.

Monthly discharge of Umpqua River near Elkton, Oreg., for 1909.

[Drainage area, 3,680 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	93,000	6,070	31,400	8.53	9.83	1,930,000	C.
February	38,000	9,880	21,100	5.73	5.97	1,170,000	B.
March	23,200	6,180	10,800	2.93	3.38	664,000	B.
April	7,750	6,180	6,830	1.86	2.08	406,000	B.
May	7,500	2,370	5,150	1.40	1.61	317,000	B.
June	6,300	1,820	3,630	.986	1.10	216,000	B.
July	2,940	1,420	1,700	.478	.55	108,000	B.
August	1,420	1,050	a 1,210	.329	.38	74,400	C.
September	1,880	990	a 1,170	.318	.35	69,600	C.
October	2,940	1,200	a 1,540	.418	.48	94,700	C.
November	138,000	2,940	19,300	5.24	5.85	1,150,000	B.
December	38,000	6,540	16,000	4.35	5.02	984,000	B.
The year	138,000	990	9,990	2.71	36.60	7,180,000	

a Partly estimated. See footnote to daily discharges.

NORTH FORK OF UMPQUA RIVER AT WINCHESTER, OREG.

The station, which was originally established September 6, 1905, at Dixon's farmhouse 10 miles below the mouth of the East Fork of the North Fork, 3 miles west of Oak Creek, Oreg., and 9 miles northeast of Roseburg, Oreg., was moved on November 10, 1908, to the Southern Pacific Railroad bridge at Winchester, Oreg., about 6 miles north of Roseburg and 6 miles above the mouth of the stream. As no important tributaries enter between these points the records are comparable.

The present staff gage is in three sections, and is fastened to the left pier of the railroad bridge from which discharge measurements are made. The gage is about 600 feet below a power plant and about 1,200 feet below a highway bridge from which high-water measurements can be made.

During 1909 both the middle and high-water sections were washed out at different times but were replaced at the same datum. Readings during these periods were obtained by measuring down from the base of the rail and were later corrected to agree with the datum of the gage.

The stream is subject to sudden floods, caused usually by chinook winds in the spring or fall, by which the snows on the headwaters of the stream are rapidly melted.

The records obtained at this point furnish data of considerable value in connection with water-power development and irrigation, for which the waters of the river will probably be used to some extent. The data have also much scientific value, as the studies of this stream and of the South Fork afford some very interesting information concerning the run-off from forested areas.

No discharge measurements were made during 1909.

Daily gage height, in feet, of North Fork of Umpqua River at Winchester, Oreg., for 1909.

[W. J. Pearson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	3.45	5.6	3.7	3.15	4.1	2.3	1.9	1.7	2.05	4.85	7.25
2	3.4	3.55	6.0	3.9	3.3	4.1	2.3	1.9	1.7	1.9	3.7	6.1
3	4.3	4.2	5.7	3.8	3.55	3.85	2.25	1.85	1.75	1.8	3.35	5.35
4	7.3	4.15	5.5	3.65	3.8	3.7	2.25	1.85	1.7	1.75	2.75	4.9
5	9.65	4.05	5.0	3.6	3.6	3.55	2.2	1.85	1.6	1.65	2.55	4.8
6	8.3	3.85	4.8	3.5	3.4	3.35	2.8	1.8	1.7	1.6	3.15	4.35
7	9.4	3.8	4.4	3.35	3.3	3.2	2.8	1.8	1.6	1.8	2.85	4.35
8	8.7	3.6	4.4	3.3	3.25	3.1	2.5	1.9	1.7	1.7	2.6	4.6
9	6.4	4.0	4.8	3.3	3.2	3.0	2.4	1.75	1.6	1.7	3.25	8.3
10	5.15	3.85	4.5	3.4	3.2	3.0	2.3	1.8	1.6	1.6	4.05	6.25
11	4.55	3.9	4.3	3.35	3.3	2.95	2.3	1.8	1.6	1.75	4.4	5.4
12	4.15	4.15	4.0	3.25	3.2	2.95	2.25	1.8	1.65	1.75	3.55	7.3
13	4.2	5.9	3.9	3.25	3.05	2.9	2.2	1.8	1.65	1.65	3.25	9.0
14	4.9	5.75	4.0	3.35	3.0	2.85	2.15	1.8	1.65	1.6	3.1	6.8
15	9.0	5.8	4.0	3.35	3.0	2.8	2.1	1.7	1.7	1.6	2.8	5.8
16	12.0	6.2	4.3	3.35	2.9	2.9	2.1	1.7	1.65	1.6	2.6	5.1
17	9.85	9.1	4.3	3.3	2.9	2.8	2.05	1.75	1.6	1.5	2.5	4.8
18	11.4	7.3	4.0	3.3	2.85	2.8	2.05	1.7	1.6	1.65	2.7	4.5
19	10.1	7.15	3.85	3.3	2.8	2.7	2.1	1.7	1.45	1.5	5.8	4.3
20	12.2	6.4	3.3	3.35	2.8	2.65	2.05	1.7	1.45	2.15	14.5	4.1
21	13.3	6.0	3.55	3.1	2.8	2.55	2.0	1.7	1.5	2.2	7.6	3.85
22	9.65	5.15	3.45	3.05	2.8	2.5	2.0	1.7	1.5	2.1	21.4	3.7
23	7.4	4.75	3.35	3.05	2.75	2.5	2.0	1.7	1.5	1.85	23.3	3.5
24	6.0	5.3	3.35	3.0	2.7	2.5	1.95	1.7	1.55	1.75	13.5	3.45
25	5.15	5.9	3.3	3.0	2.7	2.5	1.95	1.55	1.6	1.8	9.5	3.4
26	4.6	5.4	3.4	3.05	2.8	2.45	1.95	1.7	1.6	1.75	7.4	3.35
27	4.3	5.15	3.4	3.35	3.3	2.45	2.0	1.65	1.65	1.7	6.05	3.25
28	3.95	5.6	3.4	3.6	3.55	2.4	2.0	1.55	1.65	1.6	6.65	3.05
29	3.8	.....	3.6	3.4	4.1	2.4	1.9	1.65	1.7	1.9	6.3	3.1
30	3.65	.....	3.55	3.25	3.8	2.3	1.9	1.65	2.1	2.25	9.2	3.1
31	3.95	.....	3.6	.....	4.15	.....	1.9	1.65	.....	2.35	.....	5.7

MILL CREEK NEAR ASH, OREG.

This station, established May 29, 1909, is at the outlet of Loon Lake, in the lower Umpqua River basin, in T. 23 S., R. 10 W., near Ash, 12 miles south of Scottsburg, Oreg. It is reached by stage from Drain, Oreg.

The staff gage is on the south shore of the lake about three-fourths of a mile above the outlet and near the observer's house. Discharge measurements are made by wading at the lower end of a pool just below the outlet of the lake. The gage heights have been furnished by J. G. Kelley, of Portland, Oreg.

The data are of value chiefly in connection with the development of water power. The stream has a heavy grade below the station, and Loon Lake offers a possible site for storage.

No discharge measurements were made during 1909. On account of the effect of wind the lake heights can not be used for determining the minimum discharge during the low-water season, but they can be used to determine the total run-off when sufficient discharge measurements have been obtained.

Daily gage height, in feet, of Mill Creek near Ash, Oreg., for 1909.

[John Salander, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.7	7.5	8.8	5.7	4.5	5.65	3.68	3.2	2.75	2.8	6.9	.....
2	7.5	7.8	8.7	5.8	4.45	5.45	3.02	3.2	2.75	2.9	6.85	8.6
3	7.3	9.6	9.0	5.9	4.4	.....	3.62	3.18	2.72	3.0	6.5	8.3
4	8.2	9.8	8.8	5.8	4.35	.....	3.6	3.15	2.72	3.0	6.2	7.8
5	8.75	9.5	8.75	5.85	4.3	.....	3.58	3.12	2.7	3.02	5.9	7.7
6	10.2	9.4	8.7	5.8	4.3	.....	3.6	3.1	2.7	2.98	5.85	7.55
7	10.5	9.5	8.3	5.75	4.25	4.62	3.68	3.4	2.68	.....	5.9	7.7
8	11.0	9.4	8.0	5.65	4.2	4.5	3.72	3.08	2.68	.....	6.6	8.7
9	10.05	9.2	8.0	5.55	4.2	4.05	3.7	3.05	2.65	.....	7.9	10.0
10	9.6	9.5	7.9	5.5	4.28	4.35	3.7	3.02	2.65	.....	8.6	.....
11	8.8	9.5	7.2	5.42	4.5	4.3	3.68	3.0	2.62	.....	9.1	.....
12	8.1	9.1	7.3	5.4	.....	4.2	3.68	3.0	2.6	.....	8.6	.....
13	7.8	8.9	7.1	5.3	.....	4.15	3.65	3.0	2.58	2.92	7.85	10.2
14	7.4	9.6	6.9	5.2	.....	4.1	3.6	2.98	2.58	2.92	7.45	9.9
15	8.5	9.4	6.75	5.15	.....	4.08	3.58	2.98	2.55	2.9	7.1	9.0
16	13.0	9.1	6.6	5.1	.....	4.08	3.55	2.95	2.52	2.88	6.85	8.3
17	12.0	9.7	6.45	5.02	.....	4.1	3.52	2.92	2.5	2.88	6.7	7.8
18	11.4	10.3	6.4	4.92	.....	4.08	3.48	2.9	2.5	2.88	6.4	7.55
19	10.5	10.6	6.25	4.9	.....	4.02	3.45	2.88	2.48	2.92	6.9	7.1
20	11.4	10.5	6.2	4.98	.....	4.0	3.42	2.88	2.48	3.28	9.7	6.9
21	12.05	10.4	6.3	4.8	4.12	3.95	3.4	2.88	2.5	3.95	10.02	6.7
22	13.0	9.9	6.4	4.78	4.15	3.92	3.38	2.88	2.5	4.58	13.2	6.5
23	12.0	9.2	6.3	4.72	4.1	3.9	3.35	2.88	2.48	4.6	21.4	6.4
24	10.3	8.8	6.2	4.68	4.05	3.85	3.32	2.85	2.48	4.45	16.6	6.3
25	9.4	9.8	6.05	4.65	4.02	3.82	3.3	2.85	2.52	4.3	13.0	6.2
26	8.8	10.6	5.9	4.6	4.0	3.8	3.3	2.85	2.55	4.15	11.4	6.1
27	8.1	9.8	5.8	4.6	4.0	3.78	3.28	2.82	2.58	4.02	9.7	6.0
28	7.9	9.3	5.75	4.6	4.08	3.78	3.28	2.82	2.6	4.0	8.9	5.7
29	7.7	.....	5.7	4.6	4.6	3.72	3.28	2.8	2.62	4.1	8.9	5.8
30	7.5	.....	5.65	4.55	5.3	3.7	3.25	2.78	2.7	4.85	.....	5.8
31	7.5	.....	5.6	.....	5.7	.....	3.22	2.78	.....	5.5	.....	6.5

SILETZ RIVER DRAINAGE BASIN.

DESCRIPTION.

Siletz River rises in the mountains in the western part of Polk County, Oreg., at an elevation of about 3,000 feet above sea level, flows in a general southwesterly direction to Siletz in Lincoln County, and thence winds tortuously northward and westward until it enters the Pacific Ocean through Siletz Bay, about 6 miles northwest of Kernville. Its total length is approximately 50 miles, and its drainage area measures 320 square miles.

The basin is densely timbered throughout, although some areas of logged-off lands may be found on the lower reaches of the stream.

The mean annual rainfall at the mouth of the river is 75 or 80 inches; at the headwaters it is undoubtedly as high as 150 inches. The annual run-off shows about 9 second-feet per square mile of drainage area. The records thus far shows very little variation in the total run-off of this drainage area.

SILETZ RIVER AT SILETZ, OREG.

This station was established November 25, 1905, about 1 mile above Siletz Ferry at Siletz, Oreg., near the Siletz and Toledo stage road, 9 miles north of Toledo and 6 miles below the mouth of Rock Creek.

The data collected are chiefly of scientific interest, as the river is fairly typical of the short streams draining the western slope of the Coast Range and the run-off factors obtained here are doubtless applicable to other streams similarly located. The records are also of value in connection with a possible power development near Siletz.

The staff gage is near the cable equipment. The gage datum has not been changed. The stream is subject to sudden and violent floods, and as the gaging station is somewhat inaccessible it has been impossible up to the present time to secure high-water measurements. The records for medium stages are reliable but are uncertain at low stages.

No discharge measurements were made during 1909. The cable was washed away during the flood of November 22, 1909, and has not been replaced.

Daily gage height, in feet, of Siletz River at Siletz, Oreg., for 1909.

[John Kentta, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	4.0	4.9	3.3	1.45	3.0	1.3	1.15	0.8	1.45	3.5	6.5
2	5.8	6.5	4.4	3.0	1.4	2.6	1.3	1.15	.8	1.4	13.5	5.2
3	6.5	5.6	4.1	2.8	1.5	2.3	1.3	1.15	.8	1.4	10.2	4.0
4	5.1	5.2	3.9	2.7	1.5	2.1	1.25	1.15	.75	1.4	5.7	3.8
5	4.2	5.0	4.6	2.6	1.6	2.0	1.25	1.1	.75	1.4	4.3	3.6
6	3.7	5.0	4.2	2.5	1.7	1.9	1.4	1.1	.75	1.4	3.8	3.5
7	4.2	5.2	3.7	2.4	1.9	1.8	1.5	1.1	.75	1.35	3.7	3.6
8	3.9	4.8	3.5	2.3	1.8	1.75	1.5	1.1	.75	1.35	5.5	3.6
9	3.9	4.9	3.35	2.2	1.7	1.7	1.45	1.1	.7	1.35	5.6	6.5
10	3.2	4.4	3.2	2.1	1.6	1.65	1.45	1.05	.7	1.35	6.8	5.4
11	2.9	4.0	3.1	2.0	1.6	1.6	1.6	1.05	.95	1.3	5.4	5.3
12	2.6	3.6	2.9	1.9	1.5	1.6	1.5	1.05	.95	1.3	4.5	11.8
13	2.35	4.1	2.8	1.8	1.5	1.55	1.5	1.05	.9	1.3	3.9	8.5
14	2.2	4.2	2.7	1.7	1.45	1.5	1.45	1.0	.9	1.3	3.3	5.7
15	3.2	5.4	2.6	1.65	1.45	1.5	1.4	1.0	.9	1.3	2.9	4.5
16	4.6	6.8	2.5	1.6	1.6	1.45	1.4	1.0	.9	1.25	2.7	3.7
17	5.9	10.9	2.4	1.55	1.8	1.4	1.4	1.0	.85	1.25	2.5	3.2
18	8.5	9.8	2.35	1.5	1.9	1.4	1.35	1.0	1.1	1.5	5.7	2.8
19	14.2	8.1	2.3	1.5	1.7	1.4	1.35	.95	1.1	2.55	9.4	2.6
20	11.5	6.2	2.3	1.45	1.6	1.35	1.35	.95	1.05	2.8	11.3	2.4
21	11.2	5.9	2.25	1.45	1.5	1.35	1.3	.95	1.05	2.9	7.2	2.3
22	8.1	4.0	2.2	1.4	1.4	1.3	1.3	.9	1.05	2.8	21.8	2.2
23	5.8	4.1	2.15	1.35	1.3	1.3	1.25	.9	1.0	2.8	16.3	2.2
24	4.6	3.8	2.1	1.3	1.3	1.3	1.25	.9	1.0	2.6	13.4	2.1
25	3.8	5.1	2.1	1.3	1.4	1.25	1.25	.9	1.5	2.3	8.0	2.1
26	3.35	4.1	2.05	1.4	1.4	1.25	1.25	.85	1.55	2.0	5.8	2.1
27	3.1	4.8	2.0	1.6	1.6	1.3	1.2	.85	1.5	1.8	4.6	2.05
28	2.95	4.9	2.0	1.5	1.7	1.5	1.2	.85	1.5	1.7	5.1	2.0
29	2.8	.....	2.1	1.5	3.6	1.4	1.2	.85	1.45	1.8	8.6	2.0
30	2.7	.....	2.3	1.45	3.2	1.4	1.2	.85	1.45	1.9	11.2	2.5
31	3.1	.....	3.6	.....	3.5	.....	1.15	.8	.....	2.9	.....	2.4

NOTE.—Flood of Nov. 22 reached a maximum stage of 24.6 feet as determined by levels to observer's high-water mark.

COLUMBIA RIVER DRAINAGE BASIN.

DESCRIPTION.

Columbia River has its source in Columbia Lake, in the eastern division of the Kootenai district, in British Columbia. From Columbia Lake it flows north to the fifty-second parallel of latitude, turns

abruptly southward, nearly paralleling its former course, flows through a series of narrow lakes, and crosses the international boundary line near the northeast corner of the State of Washington, where it receives Clark Fork. After traversing Washington in a general southerly direction, it turns westward and forms the boundary lines between Washington and Oregon, and empties into the Pacific Ocean at the forty-sixth parallel of latitude.

The total drainage area of the Columbia is estimated from the best available maps to be 259,000 square miles, divided as follows:

Area of Columbia River drainage basin.

	Square miles.
Oregon	55,370
Washington	48,000
Idaho	81,380
Montana	25,000
Nevada	5,280
Wyoming	5,270
British Columbia	38,700

This area is limited on the east by the Rocky Mountains and is traversed north and south by the Cascade and Coast ranges. Between the mountain ranges are rolling, rough, and mountainous table-lands. Mean altitudes range from sea level near the mouth of the river to 8,000 feet in the Rocky Mountains, 5,000 feet in the Cascade Range, 1,000 to 4,000 feet in the intervening table-lands. Many peaks in the mountain ranges extend into the region of eternal snow, the highest in the Cascade Range, including Mount Baker (10,827 feet), Mount Rainier (14,360 feet), Mount Adams (12,307 feet), Mount Hood (11,225 feet), and Mount Jefferson (10,200 feet).

The principal tributaries of Columbia River from the source to the mouth are listed in the following table:

Principal tributaries of Columbia River.

From the west and north.	From the east and south.
Kettle River.	Kootenai River.
Sanpoil River.	Clark Fork.
Okanogan River.	Colville River.
Methow River.	Spokane River.
Chelan River.	Snake (Lewis Fork) River.
Entiat River.	Walla Walla River.
Wenatchee River.	Umatilla River.
Yakima River.	Willow Creek.
Klickitat River.	John Day River.
White Salmon River.	Deschutes River.
Lewis River.	Hood River.
Kalama River.	Willamette River.
Cowlitz River.	Clatskanie Creek.

The river is navigable in long stretches throughout its course in the United States, but owing to rapids and falls continuous navigation is not possible in the natural condition of the river. The navigable waters of the Columbia and its tributaries aggregate a total of 2,136 miles, distributed as follows:

Navigable waters of Columbia River and tributaries.[1]

	Miles.
From the ocean to mouth of Willamette River	102
Mouth Willamette to The Dalles, 88 miles; to Big Eddy	92
Big Eddy to Celilo, obstructed for 9 miles.	
*Celilo to Priest Rapids	198
Foot Priest Rapids to head rapids, obstructed 11½ miles.	
*Head Priest Rapids to Wenatchee	57
Wenatchee to mouth of Okanogan River	68
Mouth of Okanogan to Spokane Rapids, navigable at great risk only, a distance of 109 miles.	
*Spokane Rapids to Rickey's landing	56
Rickey's landing to Marcus, Wash., not navigable 11 miles.	
Marcus to Robson, B. C	63
Robson to Arrowhead Landing, B. C	124
Total navigable waters, main stream	760
SNAKE RIVER.	
*Mouth to Riparia	67
Riparia to Lewiston	73
*Lewiston to Grande Ronde River	25
Grande Ronde River to Ballard's landing, obstructed 175 miles.	
*Ballard's landing to Huntington	75
Total navigable waters, Snake River	240
WILLAMETTE RIVER AND TRIBUTARIES.	
Mouth to Corvallis	118
*Corvallis to Eugene	53
*Tualatin River, mouth to head of navigation	25
Yamhill River, mouth to McMinnville	18
*Long Tom River, mouth to head of navigation	10
Total navigable waters, Willamette and tributaries	224
OTHER TRIBUTARIES OF COLUMBIA RIVER.	
Clatskanie River, navigable on tide above mouth	3
Lewis River, mouth to La Center	7
Cowlitz River, mouth to point 10 miles above Toledo	40
Lake Chelan, Lakeside, at foot of Lake, to Stehekin	50
Clark Fork and Lake Pend Oreille, Lakeview to Box Canyon	116

[1] Parts of the Columbia and its tributaries marked with asterisk are navigable under favorable conditions. Practically all these stretches of river can be made navigable at all seasons of the year. The Columbia and Snake Rivers were formerly navigated throughout the year, except during occasional blockades from ice, from Celilo to Lewiston. It will be noted that part of Snake River, from mouth to Riparia, is now marked "navigable under favorable conditions."

	Miles.
Box Canyon to Metaline, navigable at high water at great risk only, a distance of 6 miles.	
Cœur d'Alene Lake, Cœur d'Alene City to head lake	24
Cœur d'Alene River, mouth to Mission Landing	32
Upper and Lower Kootenai Rivers, Golden, B. C., to Jennings, Mont.	259
Jennings to Bonners Ferry, not navigable, 75 miles.	
Bonners Ferry to head Kootenai Lake	239
Nelson to mouth at Robson, 25 miles, not navigable.	
*Okanogan River, mouth to international boundary	87
International Boundary to Penticton, 37 miles, not navigable.	
Penticton to Okanogan Landing	55
Total navigable waters, other tributaries	912

The improvement of this river system for navigation is being carried on as rapidly as funds will permit. The work at present under way consists, briefly, of the deepening of the mouth of the Columbia River through the construction of jetties. It is expected that when projects now under way are completed a depth of 40 feet may, if necessary, be obtained. The opening of the Cascade locks and canals to traffic in 1896 rendered the river navigable in one unit from the mouth to Big Eddy. When the projected locks and canal have been constructed around the obstructions between Celilo and Big Eddy, a distance of about 8½ miles, the Columbia will be open to steamboat navigation from Priest Rapids to the sea—a distance of 400 miles.

The area drained by the Columbia includes perhaps the largest consolidated area of forests in the world. Originally almost the entire area, except those arid portions midway between the mountain ranges, was covered with dense forests, and although the territory has been settled for about 65 years and large areas have been cleared, the ratio of forested area to the entire area has been reduced but slightly.

The rainfall is distributed over the area most irregularly. From the Pacific coast eastward to the summit of the Coast Range the mean annual rainfall varies from 100 to 150 inches. In the basins between the Coast and Cascade ranges, it drops to about 40 inches per annum. It increases again to about 100 inches on the summit of the Cascade Range, and decreases very rapidly beyond the summit, until at the eastern base of the Cascades it has dropped to about 14 inches. At the mouth of Snake River the mean annual rainfall is about 9 inches, but this extremely low rainfall obtains only in the lower altitudes. Beyond this point the rainfall again increases in Washington and northern Idaho to about 20 inches, while in eastern Oregon it continues at about 9 inches or less. In the eastern areas a large proportion of precipitation appears as snow, and during the winter months the streams are more or less icebound. West of the

Cascade Range, however, the winter stream flow is not affected by ice.

The climate of the area exhibits all the variations from the rigorous climate of the northern latitudes, as found in British Columbia and the higher table-lands of Oregon and Idaho, to the mild climate of western Oregon and Washington.

As regards agriculture, the area ranges from the extremely arid region, where irrigation is absolutely essential, through the semiarid country, where dry farming and irrigation are practiced side by side, to the humid country that, strictly speaking, is arid in the summer months. In the Willamette Valley, for instance, where the mean annual rainfall is approximately 40 inches, only 5 per cent of this amount is received during the growing season, and the fullest agricultural development will not be realized until this entire portion of the area is under the irrigation ditch as completely as are the arid portions beyond the mountains. The irrigated areas of the Pacific Northwest are being extended so rapidly that it is almost impossible to keep pace with the development, and yet, comparatively speaking, a very small portion of the irrigable area has been developed. At present 1,500,000 acres of land are under irrigation in the Northwest, and this area will be more than doubled when projects now being constructed are completed. The values of irrigated agricultural lands vary from about $30 per acre for the poorest qualities of hay lands to $3,000 per acre for the intensely cultivated orchards.

Columbia River and its tributaries afford at least one-third of the available water powers in the entire United States, but developments along this line have scarcely begun. About 150,000 horsepower are at present developed by water power in Oregon, Washington, and Idaho.

Lumbering has been the principal industry of the Northwest, and the streams of the country have therefore been used not only for water-power development but for the transportation of logs from the timbered mountain slopes to the mills and factories in the valleys below. Comparatively few streams, however, carry sufficient water during the summer months, and it has been necessary to build temporary dams on a large number of streams, where the logs are stored until released by opening the gates in the dam. The "splash" thus caused usually suffices to carry the logs to their destination.

The highest recorded flood in Columbia River occurred in June, 1894. The highest floods on the tributaries are invariably caused by the "chinook"—a warm wind, usually accompanied by rain, occurring in the spring and fall. The fall "chinook" usually brings the highest waters, as it may occur immediately after a heavy snow has covered the mountain ranges. The Columbia itself is not greatly affected at such times.

The following special reports contain information regarding the surface waters of Columbia River basin:

Water-Supply Paper 253, Water powers of the Cascade Range, Part I, southern Washington, contains stream flow data and river profiles on rivers in Klickitat, White Salmon, Little White Salmon, and Lewis River drainage basins.

Supplement to First Biennial Report of the State Engineer of Oregon, 1906, contains all data on Oregon streams, compiled from published records of the United States Geological Survey.

COLUMBIA RIVER NEAR PASCO, WASH.

This station was established October 15, 1904, at the Northern Pacific Railway bridge near Pasco, Wash., 4 miles above the mouth of Snake River and 7 miles below the mouth of Yakima River.

One discharge measurement has been made at this station. The gage heights are complete. Future measurements are needed to develop a rating curve to which the gage heights can be applied.

Since September 1, 1908, the records have been furnished by the United States Weather Bureau. The gage datum used by the United States Geological Survey is 307.75 feet above sea level; the datum of the Weather Bureau gage is 10 feet higher. The gage heights published below are referred to the Survey datum.

Daily gage height, in feet, of Columbia River near Pasco, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	8.4	9.8	9.0	10.6	13.6	22.1	26.6	19.8	13.9	11.3	10.1	14.5
2	8.4	9.7	9.1	10.8	13.3	22.8	26.3	19.6	13.8	11.3	10.0	15.0
3	8.3	9.7	9.1	10.9	13.2	24.0	26.1	19.4	13.8	11.3	10.9	15.3
4	8.3	9.6	9.2	11.0	13.2	25.1	25.9	19.3	13.6	11.3	10.8	14.7
5	.....	9.6	9.3	11.0	13.3	27.0	25.7	19.1	13.5	11.3	10.5	14.0
6	.....	9.5	9.4	11.0	14.8	27.7	25.5	18.9	13.5	11.3	11.0	13.7
7	.....	9.5	9.4	10.9	15.7	27.9	25.4	18.7	13.5	11.3	10.9	13.5
8	.....	9.4	9.4	10.9	15.7	27.7	25.3	18.5	13.4	11.3	10.9	13.4
9	.....	9.3	9.2	10.7	15.0	27.5	25.2	18.1	13.3	11.3	10.9	13.2
10	.....	9.2	9.3	10.6	14.8	27.4	25.3	17.9	13.2	11.3	10.9	13.2
11	.....	9.1	9.3	10.7	15.1	27.1	25.3	17.6	13.2	11.3	11.0	13.2
12	.....	9.0	9.3	10.8	15.2	27.2	25.2	17.3	13.2	11.3	11.0	13.1
13	.....	8.8	9.3	10.9	15.3	27.1	25.2	16.9	13.2	11.3	11.0	13.0
14	.....	8.7	9.1	11.1	15.3	27.5	25.0	16.6	13.2	11.4	10.9	12.8
15	.....	8.6	9.0	11.5	15.2	27.8	24.8	16.3	13.3	11.4	10.8	12.7
16	.....	8.8	9.1	11.6	15.4	28.1	24.6	16.1	13.3	11.4	10.6	12.7
17	7.5	9.2	9.1	11.7	15.7	28.6	24.2	15.9	13.1	11.4	10.5	12.5
18	8.5	9.5	9.3	11.8	16.1	29.0	23.8	15.8	13.0	11.4	10.3	12.4
19	11.0	9.9	9.5	12.0	16.5	29.1	23.3	15.6	12.9	11.3	10.3	12.2
20	11.5	10.4	9.6	12.0	16.5	29.4	22.8	15.5	12.7	11.2	10.4	12.0
21	12.5	10.1	9.6	12.0	16.6	29.2	22.5	15.4	12.6	11.0	11.4	11.8
22	12.5	9.8	9.5	12.2	17.0	28.5	22.2	15.3	12.4	10.9	11.5	11.7
23	12.8	9.5	9.3	12.2	17.1	27.7	21.8	15.2	12.4	10.9	11.5	11.5
24	12.7	9.3	9.3	12.2	17.3	27.2	21.5	15.0	12.3	10.9	13.0	11.1
25	11.7	9.1	9.4	12.3	17.5	27.2	21.2	14.9	12.1	10.8	14.0	11.0
26	11.0	9.1	9.3	12.3	17.7	26.8	20.9	14.7	11.9	10.7	15.1	10.8
27	10.5	9.0	9.5	12.9	18.7	26.4	20.6	14.6	11.8	10.6	15.3	10.6
28	10.4	9.0	9.7	13.5	19.7	26.0	20.3	14.5	11.7	10.4	14.4	10.6
29	10.2	.....	10.0	13.7	21.0	25.6	20.3	14.3	11.5	10.3	13.6	10.5
30	10.0	.....	10.3	13.8	21.8	25.0	20.3	14.2	11.3	10.2	13.6	10.4
31	9.9	.....	10.4	.....	22.3	.....	20.0	14.0	.....	10.2	.....	10.3

NOTE.—River reported "frozen" Jan. 5 to 16.

COLUMBIA RIVER AT THE DALLES, OREG.

This station is located 2,000 feet below the ferry at The Dalles, Oreg., and is below the mouth of Deschutes River and above Hood and Klickitat rivers.

There are two gages at The Dalles, the Government, or Brooks gage, used by the United States Geological Survey, made up of several sections attached to piling of the viaduct connecting Regulator Dock with the warehouse; and the United States Army engineer's gage, which is similar but has a datum 8.9 feet lower than the Brooks gage.

Discharge measurements are made from a gasoline launch held in position by a cable sagging into the water in order to allow the passage of river steamers. The cable is stretched at time of each measurement.

A comparison has been made between the gage readings at The Dalles and those taken at Cascade Locks, 20 miles down the river, at which point the gage records are nearly complete for 30 years. The elevation of the gage datum at The Dalles is 45.6 feet and at Cascade Locks 42.5 feet above sea level.

When the locks were formally opened in 1896 the gage was moved and a datum 6 feet lower was used until December 31, 1899. The condition at the locks are such that a permanent rating is perfectly feasible.

Records of gage heights have been kept at The Dalles by the United States Weather Bureau since 1892. A number of measurements were made in 1903 by the United States Army engineers. In 1907 and 1908 measurements were made by the United States Geological Survey, and these in connection with earlier measurements fully develop the discharge curve.[1]

No discharge measurements were made in 1909.

Daily gage height, in feet, of Columbia River at The Dalles, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.6	.....	4.4	7.2	11.5	24.6	32.6	18.0	8.1	4.7	3.3	11.1
2	.6	.....	4.3	7.8	11.0	24.6	32.1	17.5	7.9	4.5	3.7	11.6
3	.9	.....	4.5	8.0	10.6	26.2	31.9	17.1	7.8	4.6	4.2	12.2
4	1.2	4.0	4.6	8.3	10.5	29.5	31.4	16.7	7.8	4.8	4.5	12.0
5	.7	4.0	4.8	8.5	10.4	32.3	30.9	16.4	7.5	4.7	4.5	11.2
6	.5	3.9	4.9	8.5	11.4	34.5	30.3	15.9	7.5	4.6	5.3	10.4
7	.3	3.8	5.2	8.1	12.8	36.1	30.0	15.6	7.5	4.6	5.3	9.4
8	.2	3.7	5.4	7.8	13.4	36.4	29.6	15.2	7.6	4.6	5.0	8.8
9	.1	3.6	5.3	7.6	13.5	36.0	29.2	14.9	7.4	4.6	5.0	8.7
10	.0	3.5	5.1	7.7	13.0	35.4	28.9	14.5	7.4	4.6	5.0	8.6
11	.0	3.4	4.8	7.5	12.8	34.8	28.9	13.9	7.4	4.6	4.8	8.5
12	.2	3.2	4.7	7.6	13.0	34.4	28.6	13.5	7.3	4.7	4.8	8.7
13	.3	3.0	4.7	8.0	13.4	34.3	28.5	13.9	7.3	4.8	4.9	9.4
14	.4	2.8	4.4	7.8	13.2	34.5	28.4	13.5	7.2	4.8	4.8	9.0
15	.5	2.7	3.7	8.1	13.2	34.7	28.0	12.9	7.2	4.7	4.6	8.6

[1] A detailed study of conditions was made by engineers of the United States Geological Survey, and the results, including discharge measurements, rating curve, rating tables, and monthly discharges for 1879 to 1908 published in Water-Supply Paper 252, pp. 67-80.

Daily gage height, in feet, of Columbia River at The Dalles, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.0	3.0	3.6	8.4	13.0	35.3	27.2	12.5	7.1	4.7	4.4	8.5
17	1.5	4.8	3.5	8.8	13.0	36.0	26.4	11.1	7.1	4.6	4.2	8.1
18	2.4	5.0	4.8	8.7	13.5	37.2	25.4	10.7	7.0	4.4	4.0	7.6
19	3.3	6.3	5.1	9.2	14.2	38.1	24.5	10.6	6.9	4.3	4.6	7.4
20	15.4	6.9	5.3	9.6	14.7	37.7	23.8	10.5	6.8	4.3	5.5	7.1
21	17.5	7.8	5.3	9.4	14.6	37.7	23.1	10.4	6.7	4.2	5.5	6.8
22	17.5	7.0	5.4	9.2	14.9	37.5	22.7	10.1	6.4	4.1	6.0	6.5
23	15.2	6.4	5.5	9.0	15.5	36.9	21.9	10.0	6.0	4.0	9.1	6.1
24	13.5	5.7	5.8	9.0	15.9	36.4	21.3	9.8	6.1	4.2	10.1	5.5
25	11.8	5.3	5.2	8.8	16.0	35.8	20.4	9.5	6.1	4.2	10.5	4.9
26	6.0	5.1	5.2	8.6	16.3	35.2	19.8	9.4	5.9	4.0	12.0	4.7
27	3.0	4.9	5.7	8.7	16.8	34.7	19.2	9.1	5.4	3.8	13.6	4.4
28	1.5	4.6	5.8	9.9	18.3	34.1	18.5	8.6	5.4	3.7	13.8	4.2
29	1.0	.....	6.4	11.3	20.4	33.5	18.1	8.5	5.2	3.6	12.8	4.1
30	.....	.....	6.8	11.4	22.9	33.0	18.2	8.5	4.9	3.5	12.2	4.0
31	.....	.....	7.0	.....	24.2	.....	18.4	8.3	.....	3.4	.....	4.2

NOTE.—An ice jam, Jan. 11 to 27, at the Celilo Rapids 5 to 10 miles above the gaging station, acted as a dam but released the stored water when the jam broke up as result of heavy rains in Oregon. Gage heights during the first part of this period are abnormally low on account of jam.

Daily discharge, in second-feet, of Columbia River at The Dalles, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	Apr.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	66,200	82,000	99,000	128,000	188,000	441,000	628,000	302,000	139,000	102,000	88,700	182,000
2	66,200	86,300	98,000	136,000	180,000	441,000	616,000	292,000	137,000	100,000	92,300	189,000
3	68,300	90,700	100,000	138,000	174,000	478,000	612,000	285,000	136,000	101,000	97,000	198,000
4	70,600	95,000	101,000	142,000	172,000	554,000	600,000	277,000	136,000	103,000	100,000	195,000
5	66,900	95,000	103,000	144,000	171,000	621,000	588,000	272,000	132,000	102,000	100,000	183,000
6	65,500	94,100	104,000	144,000	186,000	676,000	573,000	262,000	132,000	101,000	108,000	171,000
7	64,100	93,200	107,000	139,000	208,000	717,000	566,000	257,000	132,000	101,000	108,000	157,000
8	63,400	92,300	109,000	136,000	218,000	724,800	556,000	250,000	133,000	101,000	105,000	148,000
9	62,700	91,400	108,000	133,000	220,000	714,000	547,000	244,000	131,000	101,000	105,000	147,000
10	62,000	90,500	106,000	134,000	211,000	698,000	540,000	237,000	131,000	101,000	105,000	146,000
11	62,000	89,600	103,000	132,000	208,000	683,000	540,000	226,000	131,000	101,000	103,000	144,000
12	63,400	87,800	102,000	133,000	211,000	673,000	533,000	220,000	130,000	102,000	103,000	147,000
13	64,100	86,000	102,000	138,000	218,000	670,000	530,000	226,000	130,000	103,000	104,000	157,000
14	64,800	84,200	99,000	136,000	214,000	676,000	528,000	220,000	128,000	103,000	103,000	151,000
15	65,500	83,300	92,300	139,000	214,000	680,000	519,000	209,000	128,000	102,000	101,000	146,000
16	69,000	86,000	91,400	143,000	211,000	696,000	501,000	203,000	127,000	102,000	99,000	144,000
17	73,000	103,000	90,500	148,000	211,000	714,000	482,000	182,000	127,000	101,000	97,000	139,000
18	80,600	105,000	103,000	147,000	220,000	745,000	459,000	176,000	126,000	99,000	95,000	133,000
19	88,700	118,000	106,000	154,000	232,000	769,000	439,000	174,000	125,000	98,000	101,000	131,000
20	253,000	125,000	108,000	159,000	241,000	758,000	424,000	172,000	124,000	98,000	110,000	127,000
21	292,000	136,000	108,000	157,000	239,000	758,000	408,000	171,000	123,000	97,000	110,000	124,000
22	292,000	126,000	109,000	154,000	244,000	753,000	399,000	166,000	119,000	96,000	115,000	120,000
23	250,000	119,000	110,000	151,000	255,000	737,000	382,000	165,000	115,000	95,000	152,000	116,000
24	220,000	112,000	113,000	151,000	262,000	724,000	369,000	162,000	116,000	97,000	166,000	110,000
25	192,000	108,000	107,000	148,000	264,000	709,000	350,000	158,000	116,000	97,000	172,000	104,000
26	115,000	106,000	107,000	146,000	270,000	693,000	338,000	157,000	114,000	95,000	195,000	102,000
27	86,000	104,000	112,000	147,000	279,000	680,000	326,000	152,000	109,000	93,200	221,000	99,000
28	73,000	101,000	113,000	164,000	308,000	666,000	312,000	146,000	109,000	92,300	225,000	97,000
29	69,000	.....	119,000	184,000	350,000	650,000	304,000	144,000	107,000	91,400	208,000	96,000
30	73,300	.....	124,000	186,000	404,000	638,000	306,000	144,000	104,000	90,500	198,000	95,000
31	77,700	.....	126,000	.....	432,000	.....	310,000	142,000	.....	89,600	.....	97,000

NOTE.—These discharges are based on a rating curve that is well defined between 69,000 and 740,000 second-feet. The curve is the same as that used in computing the 1892 to 1908 data, Water-Supply Paper No. 252, p. 71.

As a result of an ice jam, Jan. 11 to 27, the daily discharges are abnormally low during the first part of this period. The rise of Jan. 20 to 26 was caused by heavy rains in Oregon.

Daily discharges Jan. 30 to Feb. 3 interpolated.

Monthly discharge of Columbia River at The Dalles, Oreg., for 1909.

[Drainage area, 237,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	292,000	62,000	106,000	0.447	0.52	6,520,000	C.
February	136,000	82,000	99,700	.421	.44	5,540,000	B.
March	126,000	90,500	106,000	.447	.52	6,520,000	A.
April	186,000	128,000	146,000	.616	.69	8,690,000	A.
May	432,000	171,000	239,000	1.01	1.16	14,700,000	A.
June	769,000	441,000	671,000	2.83	3.16	40,200,000	A.
July	628,000	304,000	470,000	1.98	2.28	28,900,000	A.
August	302,000	142,000	206,000	.869	1.00	12,700,000	A.
September	139,000	104,000	121,000	.511	.57	7,200,000	A.
October	103,000	89,600	98,600	.416	.48	6,060,000	A.
November	225,000	88,700	126,000	.532	.59	7,500,000	A.
December	198,000	95,000	139,000	.586	.68	8,550,000	A.
The year	769,000	62,000	211,000	.890	12.09	153,000,000	

CLARK FORK DRAINAGE BASIN.

DESCRIPTION.

Clark Fork of Columbia River rises in the Silverbow Mountains, Montana, about 18 miles southwest of Butte. For about 40 miles it flows northward, but near Garrison, Powell County, it turns to the northwest and maintains this general course through a distance of about 125 miles until it reaches St. Regis, in Missoula County, where it turns abruptly to the northeast. At Paradise, in Sanders County, it resumes its northwesterly course, passing between the Cœur d'Alene and Cabinet ranges, crossing the "panhandle" of Idaho in Bonner County, flowing through Lake Pend Oreille, and entering Washington at Newport in Stevens County. From Usk to the international boundary line its course is northward, and just beyond the boundary it turns directly west to its junction with the Columbia just inside Canadian territory. From source to mouth its length, exclusive of windings, is, roughly, 420 miles, and its drainage area measures 25,800 square miles. To the river thus described various names have been applied[1] and may still be used locally.

The General Land Office maps of Montana, Idaho, and Washington on which the Clark Fork drainage area is shown indicate more than 150 tributary streams, but by far the greater number of these are very short, and scarcely a dozen can be called rivers. The most important are listed in the table following.

[1] Clark Fork; river in Idaho, Montana, and Washington. (Not Bitter Root, Bitterroot, Clarke, Clarks River, Deer Lodge, Deerlodge, Hell Gate, Hellgate, Missoula, Silver Bow, nor Silverbow.) See Third Report U. S. Board Geog. Names, 1907, p. 51.

Bitterroot in this decision refers to a portion of the main stream so called, and not to the tributary known as Bitterroot River.

Principal tributaries of Clark Fork of Columbia River.

From the south and west.	From the north and east.
Flint Creek.	Little Blackfoot River.
Rock Creek.	Big Blackfoot River.
Bitterroot River.	Flathead River.
	Thompson River.
	Vermillion Creek.
	Priest River.
	Salmon River (British Columbia).

The river leaves the Silverbow Mountains near the Continental Divide at an elevation of about 5,000 feet above sea level and flows through a valley 3 or 4 miles wide, bounded by rolling hills. At Garrison it is 4,300 feet above sea. From Garrison the valley gradually narrows to a mile or less at Missoula (elevation 3,200 feet), broadens out just west of Missoula near the mouth of the Bitterroot, and again narrows as the river approaches the Mission Range. Many of the peaks in this range exceed 8,000 feet in altitude. At Paradise the stream is about 2,500 feet above sea level, and at Pend Oreille Lake the elevation is 1,900 feet. Its course through Washington and British Columbia is in a deep canyon bordered in places by narrow benches. Through the unsurveyed portion in Washington this canyon is wild and picturesque. The river has many rapids and falls, and in places the rocky gorge is narrow enough to be spanned by foot logs. The stream falls nearly 500 feet in the last 40 miles of its course. The elevation of Boundary is 1,346 feet.

A great deal of snow lies in the mountains from November to June, and many of the streams are frozen over in the colder months. During the greater part of the year, however, the streams are open, because of the milder climate on the western slope of the Continental Divide.

Irrigation in the Bitterroot Valley has been developed quite extensively. A large private enterprise near Hamilton is now completed. The United States Reclamation Service is irrigating the Flathead Indian Reservation by diverting water from the smaller streams. A project to dam Flathead River and develop power for pumping water from the lake is now under way. One hundred thousand acres will be irrigated on the Flathead.

Reservoir sites available for storage are numerous. The Mission Range has several that will be used by the Reclamation Service; also good storage-reservoir sites are to be found on the Bitterroot and upper Little Bitterroot.

The drainage basin contains many valuable power streams. On a few streams power plants have already been installed and more are under construction. The lower 20 miles of the main river offers some exceptional opportunities for power developments in large units.

The run-off records extend back to 1898. During this period, 1899 was the wettest year and 1905 was the driest.

CLARK FORK AT NEWPORT, WASH.

A station on Clark Fork was established at Priest River, Idaho, June 26, 1903, but was discontinued April 30, 1905. The gage was located 1,000 feet downstream from Priest River railroad station and one-fourth mile below the mouth of Priest River.

Gage records were begun at Newport, Wash., by the United States Weather Bureau in April, 1904, and they have been continuous from that date, except for the months of December, January, and February. The winter records are complete for 1903 to 1906.

The Weather Bureau gage is attached to the dock of the Pend Oreille River Navigation Co. on the left bank of the river.

High-water sections are set in line with each other at several locations on the river bank.

Gage heights are furnished by the United States Weather Bureau.

By comparing simultaneous gage readings at Priest River and Newport from April, 1904, to April, 1905, a very satisfactory relation has been established.

The results of this study, including discharge measurements, rating table, and monthly discharge from 1904 to 1908, were published in Water-Supply Paper 252, pages 85–89.

No discharge measurements were made in 1909, but the conditions are practically permanent and good results have been obtained.

Daily gage height, in feet, of Clark Fork at Newport, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	−0.1	0.4	2.4	10.0	17.0	6.7	1.9	0.3	−0.3
2	− .1	.5	2.6	10.6	16.8	6.5	1.8	.3	− .2
3	− .1	.7	2.7	11.3	16.4	6.4	1.7	.2	− .1
4	− .2	.7	2.7	12.0	16.0	6.0	1.5	.2	+ .1
5	− .2	.8	2.5	12.7	15.6	5.9	1.3	.2	+ .3
6	.0	.9	2.8	13.5	15.2	5.8	1.2	.2	.4
7	.0	.9	3.2	14.2	14.8	5.7	1.1	.2	.6
8	− .1	1.0	3.5	15.0	14.5	5.5	1.1	.1	.8
9	− .2	1.0	3.8	15.6	14.3	5.2	1.0	.0	.8
10	− .1	1.1	3.9	16.3	13.8	5.0	.9	− .1	.8
11	− .1	1.1	4.0	16.6	13.5	4.9	.9	.0	.8
12	− .2	1.0	4.1	17.2	13.2	4.7	.8	.0	.5
13	− .2	.9	4.3	17.3	12.8	4.5	.8	.0	.3
14	− .2	1.1	4.5	17.6	12.5	4.4	.8	.0	.2
15	− .2	1.1	4.5	17.6	12.1	4.2	.8	.0	.0
16	− .3	1.1	4.6	17.6	11.5	4.0	.8	.0	− .1
17	− .3	1.3	4.8	17.7	11.2	3.8	.7	.0	− .1
18	− .3	1.3	4.9	17.8	10.9	3.7	.7	.0	− .1
19	− .3	1.4	5.0	17.9	10.5	3.5	.6	− .1	.0
20	− .2	1.5	5.1	18.0	10.1	3.1	.5	− .1	+ .1
21	− .1	1.5	5.3	18.2	9.8	3.0	.5	− .1	+ .4
22	− .2	1.5	5.5	18.3	9.4	2.9	.5	− .1	1.0
23	− .1	1.6	5.8	18.4	9.0	2.8	.5	− .1	1.4
24	− .1	1.6	5.9	18.5	8.6	2.7	.4	− .1	1.8
25	− .2	1.7	6.1	18.6	8.3	2.6	.3	− .2	2.1
26	.0	1.7	6.4	18.6	8.1	2.5	.3	− .2	2.6
27	.0	2.0	6.8	18.5	7.7	2.4	.3	− .3	2.8
28	+ .1	2.1	7.3	18.0	7.5	2.3	.3	− .3	3.0
29	+ .3	2.4	7.9	17.7	7.3	2.2	.3	− .3	3.2
30	+ .3	2.4	8.6	17.4	7.1	2.1	.3	− .3	3.3
31	+ .4	.....	9.1	.....	6.9	2.0	.....	− .3	.....

Daily discharge, in second-feet, of Clark Fork at Newport, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10,500	15,600	11,400	12,900	19,900	57,200	106,000	39,300	17,900	12,600	10,800	23,500
2	9,470	15,400	11,400	13,200	20,700	60,700	104,000	38,300	17,600	12,600	11,100	24,000
3	7,720	15,200	11,400	13,800	21,100	64,800	101,000	37,800	17,200	12,300	11,400	24,400
4	7,900	14,900	11,100	13,800	21,100	69,100	97,300	35,800	16,500	12,300	12,000	25,100
5	9,470	14,300	11,100	14,100	20,300	73,400	94,100	35,400	15,800	12,300	12,600	25,300
6	8,900	14,200	11,700	14,400	21,500	78,600	90,900	34,900	15,400	12,300	12,900	25,500
7	7,900	14,000	11,700	14,400	23,200	83,400	87,800	34,400	15,100	12,300	13,500	25,100
8	7,400	13,800	11,400	14,800	24,400	89,300	85,600	33,400	15,100	12,000	14,100	25,100
9	7,900	13,200	11,100	14,800	25,700	94,100	84,200	32,000	14,800	11,700	14,100	24,000
10	7,900	13,200	11,400	15,100	26,100	100,000	80,600	31,100	14,400	11,400	14,100	22,900
11	7,810	12,400	11,400	15,100	26,600	103,000	78,600	30,600	14,400	11,700	14,100	22,700
12	8,270	11,800	11,100	14,800	27,000	108,000	76,600	29,700	14,100	11,700	13,200	22,900
13	8,900	11,400	11,100	14,400	27,900	109,000	74,000	28,800	14,100	11,700	12,600	22,200
14	8,790	11,200	11,100	15,100	28,800	112,000	72,100	28,300	14,100	11,700	12,300	22,200
15	9,470	11,000	11,100	15,100	28,800	112,000	69,700	27,400	14,100	11,700	11,700	22,000
16	9,350	10,900	10,800	15,100	29,200	112,000	66,000	26,600	14,100	11,700	11,400	21,600
17	9,710	11,800	10,800	15,800	30,100	113,000	64,200	25,700	13,800	11,700	11,400	21,400
18	9,840	11,600	10,800	15,800	30,600	114,000	62,400	25,300	13,800	11,700	11,400	21,200
19	10,100	11,800	10,800	16,100	31,100	115,000	60,100	24,400	13,500	11,400	11,700	21,400
20	10,500	11,500	11,100	16,500	31,500	116,000	57,800	22,700	13,200	11,400	12,000	21,000
21	10,400	11,400	11,400	16,500	32,500	118,000	56,000	22,300	13,200	11,400	12,900	20,800
22	11,400	11,200	11,100	16,500	33,400	119,000	53,700	21,900	13,200	11,400	14,800	20,200
23	10,100	10,800	11,400	16,800	34,900	120,000	51,500	21,500	13,200	11,400	16,100	19,600
24	12,200	11,200	11,400	16,800	35,400	121,000	49,300	21,100	12,900	11,400	17,600	18,100
25	12,800	11,500	11,100	17,200	36,300	122,000	47,600	20,700	12,600	11,100	18,700	17,900
26	14,500	11,400	11,700	17,200	37,800	122,000	46,500	20,300	12,600	11,100	20,700	17,800
27	15,100	11,500	11,700	18,300	39,800	121,000	44,400	19,900	12,600	10,800	21,500	18,700
28	14,900	11,600	12,000	18,700	42,300	116,000	43,400	19,500	12,600	10,800	22,300	20,200
29	14,900	.....	12,600	19,900	45,500	113,000	42,300	1 ,100	12,600	10,800	23,200	21,000
30	15,100	.....	12,600	19,900	49,300	110,000	41,300	18,700	12,600	10,800	23,600	21,200
31	15,400	.....	12,900	.....	52,000	.....	40,300	18,300	.....	10,800	.....	21,600

NOTE.—The above daily discharges are based on a rating curve that is well defined.

The daily discharges for January, February, and December were taken as being the same as for corresponding days at Metaline, Wash.

Monthly discharge of Clark Fork at Newport, Wash., for 1909.

[Drainage area, 24,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	[illegible]an.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	15,400	7,400	10,500	0.438	0.50	646,000	B.
February	15,600	10,800	12,500	.521	.54	694,000	B.
March	12,900	10,800	11,400	.475	.55	701,000	B.
April	19,900	12,900	15,800	.658	.73	940,000	A.
May	52,000	19,900	30,800	1.28	1.48	1,890,000	A.
June	122,000	57,200	102,000	4.25	4.74	6,070,000	A.
July	106,000	40,300	68,700	2.86	3.30	4,220,000	A.
August	39,300	18,300	27,300	1.14	1.31	1,680,000	A.
September	17,900	12,600	14,200	.592	.66	845,000	A.
October	12,600	10,800	11,600	.483	.56	713,000	B.
November	23,600	10,800	14,700	.612	.68	875,000	B.
December	25,500	17,800	22,000	.917	1.06	1,350,000	B.
The year	122,000	7,400	28,500	1.19	16.11	20,600,000	

CLARK FORK AT METALINE, WASH.

This station is located at the town of Metaline, and was established November 4, 1908, by Ham, Yearsley and Ryrie, of Spokane. The gage is in two sections and is graduated in feet and tenths, one section from zero to 32 feet and the other from zero to −10 feet. Observations are taken twice daily. The data are of importance in connection with water-power development. The city of Spokane is to examine the feasibility of a municipal lighting plant near Metaline.

The following discharge measurement was made by H. L. Frazer:

October 23, 1908, gage height −1.5 feet, discharge 12,100 second-feet.

Daily gage height, in feet, of Clark Fork at Metaline, Wash., for 1908.

[Harry Doane, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1	.....	−2.0	11	−1.8	−2.4	21	−2.0	−3.2
2	.....	−2.0	12	−1.7	−2.4	22	−2.2	−3.2
3	.....	−2.0	13	−1.8	−2.5	23	−1.8	−3.2
4	−1.6	−2.1	14	−2.0	−2.6	24	−1.7	−3.2
5	−1.7	−2.2	15	−2.1	−2.5	25	−1.7	−3.3
6	−1.8	−2.4	16	−2.1	−2.4	26	−1.8	−3.2
7	−1.8	−2.5	17	−2.1	−2.5	27	−2.0	−3.4
8	−1.9	−2.4	18	−2.1	−2.5	28	−2.0	−3.3
9	−1.9	−2.4	19	−2.1	−2.7	29	−2.0	−3.3
10	−2.0	−2.5	20	−2.1	−2.8	30	−2.0	−3.4
						31	.....	−3.2

Daily gage height, in feet, of Clark Fork at Metaline, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	−2.7	0.5	−2.0	−0.9	3.0	16.0	25.3	10.9	1.6	−1.3	−2.2	4.6
2	−3.5	.4	−2.1	−.7	3.3	17.0	24.3	10.5	1.5	−1.3	−2.1	4.8
3	−5.2	.3	−2.2	−.5	3.5	17.9	24.5	10.7	1.3	−1.3	−2.1	5.0
4	−5.0	.1	−2.0	−.3	3.8	18.8	24.0	9.9	1.2	−1.3	−2.0	5.3
5	−3.5	−.2	−2.0	.3	3.5	19.5	23.5	9.4	1.0	−1.3	−1.9	5.4
6	−4.0	−.3	−2.3	.2	3.8	20.5	23.3	8.9	.8	−1.3	−1.4	5.5
7	−5.0	−.4	−2.4	.1	4.4	21.4	22.8	8.9	.6	−1.5	−1.2	5.3
8	−5.6	−.5	−2.4	.1	5.0	22.4	22.2	8.5	.3	−1.6	−.9	5.3
9	−5.0	−.9	−2.3	.2	5.5	23.0	21.5	8.0	.2	−1.6	−.7	4.8
10	−5.0	−.9	−2.4	.2	5.9	23.8	21.2	7.9	.1	−1.7	−.5	4.3
11	−5.1	−1.4	−2.5	.3	6.0	24.4	21.0	7.5	.1	−1.8	−.4	4.2
12	−4.6	−1.8	−2.6	.4	6.3	24.8	20.0	7.3	.0	−1.8	−.3	4.3
13	−4.0	−2.1	−2.7	.5	6.6	25.0	19.3	6.9	−.1	−1.8	.0	4.0
14	−4.1	−2.2	−2.8	.3	6.6	25.3	19.2	6.6	−.3	−1.8	−.1	4.0
15	−3.5	−2.3	−2.7	.4	6.9	25.5	19.0	6.3	−.4	−1.9	−.3	3.9
16	−3.6	−2.4	−2.8	.6	7.0	25.5	18.7	5.9	−.5	−1.9	−.1	3.7
17	−3.3	−1.8	−2.6	.8	7.4	25.6	17.0	5.5	−.5	−1.9	−.2	3.6
18	−3.2	−1.9	−2.4	.9	7.7	25.7	17.5	5.2	−.7	−2.0	−.1	3.5
19	−3.0	−1.8	−2.3	1.0	7.9	25.8	17.0	5.0	−.7	−2.0	.0	3.6
20	−2.7	−2.0	−2.2	1.1	8.1	25.9	15.5	4.8	−.8	−2.0	.0	3.4
21	−2.8	−2.1	−2.2	1.3	8.1	26.0	15.9	4.4	−.8	−2.1	.1	3.3
22	−2.1	−2.2	−2.1	1.4	8.7	26.3	15.5	4.0	−.9	−2.1	.4	3.0
23	−3.0	−2.5	−2.0	1.4	9.1	26.4	15.0	3.8	−1.0	−2.1	.9	2.7
24	−1.5	−2.2	−1.9	1.5	9.5	26.5	14.5	3.6	−1.0	−2.1	1.1	1.9
25	−1.1	−2.0	−1.8	1.6	9.9	26.5	13.9	3.2	−1.1	−2.1	1.4	1.8
26	−.1	−2.1	−1.7	1.7	10.5	26.5	13.5	2.8	−1.2	−2.2	2.1	1.7
27	.2	−2.0	−1.6	1.8	11.0	26.4	12.9	2.7	−1.3	−2.2	2.8	2.2
28	.1	−1.9	−1.5	2.0	12.0	26.2	12.5	2.2	−1.3	−2.2	3.3	3.0
29	.1	.....	−1.3	2.3	13.0	25.8	12.0	2.1	−1.1	−2.2	4.0	3.4
30	.2	.....	−1.2	2.8	13.9	25.3	11.7	2.0	−1.2	−2.3	4.6	3.5
31	.4	.....	−1.0	.....	14.9	.....	11.3	1.9	.....	−2.2	.....	3.7

FLATHEAD RIVER DRAINAGE BASIN.

DESCRIPTION.

Flathead River rises on the western slope of the Continental Divide in the southeastern part of British Columbia and takes a general southerly course, passing through Flathead Lake to Dixon, Mont., where it turns abruptly and flows westward to its junction with Clark Fork, about 3 miles southeast of Paradise. It is a large stream with a number of important tributaries, chief among which may be mentioned the Middle and South forks, which rise in the Rocky Mountains, in the Lewis and Clark National Forest, flow northwestward, the Middle Fork uniting with the main stream about 6 miles southwest of Belton and the South Fork near Columbia Falls; Stillwater River, which enters near Kalispel; Swan River, which comes into Flathead Lake; Little Bitterroot River, which drains the northwestern part of the Flathead Indian Reservation; and Jocko River, which drains the southeastern part of the reservation.

The valleys of the Middle and South forks and the main stream above Columbia Falls are very mountainous, but from Columbia Falls to the lake the valley is broad and fertile, and the stream is sluggish. Below the lake the river traverses the Flathead Indian Reservation, with its wide expanse of irrigable land. The river is not subject to sudden fluctuations in volume, as the lake serves to regulate its flow.

FLATHEAD RIVER ABOVE FLATHEAD LAKE.

In order to determine the relative height and slope of Flathead River above Flathead Lake at different stages three gages were established April 24, 1909.

The upper gage is located across the river from the steamboat landing at Demersville, Mont., 3 miles below Kalispel, Mont. The second gage is located near the ranch buildings of F. N. Damon, 10 miles below Kalispel and 7 miles below Demersville. The third is at Keller's ranch, 1 mile above Holt, 16 miles below Kalispel and about 6 miles above the point where it enters Flathead Lake. The zeros of the three gages are each 2,800 feet above sea level. As the current at these gages is sluggish, the river freezes entirely over during the winter months.

Daily gage height, in feet, of Flathead River at Demersville, near Kalispel, Mont., for 1909.

[S. V. Shull, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		80.5	91.7	91.4	84.8	81.0	80.0	79.5	83.0
2		80.3	93.3	91.2	84.6	80.9	80.0	79.6	82.1
3		80.4	98.0	90.9	84.5	80.7	80.0	81.6	82.3
4		81.4	100.3	90.4	84.3	80.8	79.9	84.7	84.3
5		83.5	100.6	90.2	84.0	80.85	79.9	83.4	82.5
6		84.0	100.2	89.8	83.7	80.9	80.0	83.0	82.6
7		83.6	97.2	90.2	83.5	80.8	79.9	83.7	82.4
8		82.7	94.4	89.0	83.3	80.7	79.9	82.7	82.2
9		82.3	93.4	88.15	83.1	80.7	79.8	82.8	.....
10		82.5	93.4	88.3	82.0	80.7	79.7	82.2	.....

Daily gage height, in feet, of Flathead River at Demersville, near Kalispel, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	83.4	93.3	88.0	82.8	80.6	79.7	81.7	.....
12	.....	83.3	93.3	88.4	82.6	80.7	79.7	81.5	.....
13	.....	83.3	93.6	87.2	82.5	80.7	79.8	81.3	.....
14	.....	83.3	94.3	87.6	82.4	80.6	80.0	81.0	.....
15	.....	83.4	94.8	87.2	82.2	80.5	80.0	79.8	.....
16	.....	83.7	95.6	87.0	82.7	80.4	79.9	79.6	.....
17	.....	83.8	96.5	86.7	82.5	80.4	79.9	79.5	.....
18	.....	83.7	96.5	86.7	82.3	80.2	79.8	79.9	.....
19	.....	83.5	96.2	86.0	82.1	80.0	79.8	81.0	.....
20	.....	83.2	96.3	85.2	82.0	79.9	80.0	82.3	.....
21	.....	84.4	96.0	85.5	81.9	79.9	79.9	82.0	.....
22	.....	85.8	95.5	85.2	81.7	79.9	79.8	82.4	.....
23	.....	87.8	94.4	85.5	81.5	79.8	79.7	82.0	.....
24	79.8	87.6	94.0	85.6	81.4	79.8	79.6	83.6	.....
25	79.9	88.8	93.4	85.8	81.3	79.8	79.6	84.6	.....
26	79.9	90.0	92.8	85.5	81.5	79.8	79.6	83.8	.....
27	80.3	92.0	92.2	85.0	81.5	79.9	79.5	83.4	.....
28	80.5	93.3	91.6	84.8	81.4	79.9	79.5	83.4	.....
29	80.6	93.0	91.0	86.9	81.3	80.0	79.5	82.7	.....
30	80.2	92.3	91.2	85.5	81.1	80.0	79.5	82.8	.....
31	.....	91.0	.....	85.0	81.1	.....	79.5	.....	.....

Daily gage height, in feet, of Flathead River, at Damon's ranch, near Kalispel, Mont., for 1909.

[F. N. Damon, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	80.0	88.9	89.9	84.2	81.8	80.1	79.65	82.15
2	.....	80.05	90.9	89.8	84.1	81.05	80.1	79.85	82.1
3	.....	80.1	93.1	89.5	84.0	81.0	80.05	79.9	82.05
4	.....	80.4	94.4	89.2	83.8	80.9	80.05	81.1	82.0
5	.....	81.2	94.4	88.9	83.6	80.9	80.05	82.5	81.9
6	.....	81.7	94.1	88.8	83.4	80.9	80.1	81.9	81.75
7	.....	81.5	93.2	88.8	83.2	80.8	80.1	81.55	81.6
8	.....	81.4	91.9	88.5	83.1	80.8	80.05	81.4	81.6
9	.....	81.4	91.3	88.1	82.9	80.75	80.05	81.3	81.65
10	.....	81.6	91.3	87.7	82.8	80.7	80.0	81.3	81.7
11	.....	82.0	91.3	87.5	82.8	80.7	79.95	81.2	81.8
12	.....	82.3	91.2	87.4	82.7	80.7	79.9	81.15	.....
13	.....	82.2	91.4	87.2	82.5	80.65	79.9	81.1	.....
14	.....	82.2	91.7	86.9	82.4	80.65	79.9	81.0	.....
15	.....	82.3	92.1	86.6	82.4	80.5	79.85	80.9	.....
16	.....	82.5	92.4	86.3	82.3	80.5	79.85	80.9	.....
17	.....	82.6	93.0	86.1	82.2	80.45	79.8	80.85	.....
18	.....	82.6	93.0	85.9	82.1	80.4	79.95	80.95	.....
19	.....	82.7	93.1	85.6	82.0	80.4	79.8	81.3	.....
20	.....	82.8	93.3	85.4	81.9	80.4	79.95	81.5	.....
21	.....	83.3	93.25	85.1	81.9	80.5	79.8	81.6	.....
22	.....	84.1	93.1	84.9	81.8	80.45	79.8	81.4	.....
23	.....	84.9	92.5	84.7	81.7	80.4	79.75	81.6	.....
24	79.6	85.3	92.2	84.5	81.75	80.3	79.75	82.3	.....
25	79.7	86.1	91.9	84.3	81.6	80.25	79.7	82.5	.....
26	79.7	87.5	91.4	84.2	81.6	80.2	79.7	82.7	.....
27	79.9	88.3	90.9	84.1	81.55	80.15	79.75	82.6	.....
28	80.1	89.4	90.6	84.4	81.4	80.1	79.7	82.3	.....
29	80.0	89.4	90.3	84.8	81.35	80.1	79.7	82.2	.....
30	80.0	88.8	90.05	84.5	81.3	80.15	79.65	82.15	.....
31	.....	.....	.....	84.3	81.2	.....	79.7	.....	.....

NOTE.—Nov. 15, 16, and 17 river frozen over; ice 2 inches thick. Dec. 5 river frozen over; probable ice conditions from Dec. 4 to Dec. 31.

Daily gage height, in feet, of Flathead River at Holt, Mont., for 1909.

[Ben Keller, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	79.95	87.1	89.0	83.85	81.0	80.15	79.75	81.85
2	.....	80.0	88.05	88.85	83.75	81.0	80.15	79.75	81.85
3	.....	88.0	89.15	88.6	83.65	80.95	80.15	80.1	81.8
4	.....	80.2	89.95	88.35	83.55	80.95	80.1	80.45	81.8
5	.....	80.5	90.4	88.1	83.35	80.9	80.1	80.75	81.8
6	.....	80.7	90.5	88.05	83.2	80.85	80.1	81.1	81.8
7	.....	80.85	90.25	87.9	83.1	80.85	80.1	81.1	81.75
8	.....	80.95	90.1	87.7	82.95	80.8	80.05	81.05	81.75
9	.....	81.0	90.0	87.45	82.85	80.75	80.05	81.05	81.75
10	.....	81.2	89.9	87.25	82.75	80.75	80.05	81.1	81.75
11	.....	81.3	89.8	87.0	82.65	80.6	80.05	81.0	81.7
12	.....	81.5	89.75	86.8	82.5	80.6	80.0	80.85	.....
13	.....	81.65	89.8	86.65	82.4	80.55	80.0	80.95	.....
14	.....	81.7	89.9	86.45	82.3	80.55	80.0	80.95	.....
15	.....	81.8	90.0	86.2	82.25	80.5	79.95	80.9	.....
16	.....	81.4	90.2	85.95	82.1	80.5	79.95	80.9	.....
17	.....	81.95	90.45	85.7	82.05	80.45	79.95	80.9	.....
18	.....	82.1	90.6	85.5	81.95	80.45	79.9	80.85	.....
19	.....	82.2	90.75	85.25	81.9	80.45	79.9	80.85	.....
20	.....	82.3	90.95	85.1	81.85	80.4	79.9	80.9	.....
21	.....	82.5	91.05	84.9	81.8	80.4	79.85	81.0	.....
22	.....	82.7	91.05	84.7	81.7	80.35	79.85	81.1	.....
23	.....	83.3	90.95	84.5	81.6	80.35	79.85	81.2	.....
24	79.55	83.7	90.8	84.35	81.5	80.3	79.85	81.4	.....
25	79.6	84.25	90.55	84.15	81.4	80.25	79.8	81.6	.....
26	79.65	84.95	90.3	84.0	81.38	80.25	79.8	81.8	.....
27	79.7	85.65	90.0	83.9	81.25	80.25	79.8	81.9	.....
28	79.8	86.75	89.75	84.0	81.1	80.2	79.8	81.85	.....
29	79.85	86.45	89.45	84.05	81.1	80.2	79.85	81.85	.....
30	79.9	86.9	89.25	84.0	81.1	80.2	79.75	81.85	.....
31	.....	86.75	.....	83.85	81.05	.....	79.75	.....	.....

NOTE.—Ice not reported at this station. Probably same at Kalispel, Dec. 4 to 31.

FLATHEAD LAKE AT POLSON, MONT.

This station, which was established August 23, 1908, is located at the steamboat dock at the town of Polson, Mont. Polson is at the southern extremity of the lake, 35 miles north of Ravalli, on the Northern Pacific Railway, and about the same distance south of Kalispel.

The records show the fluctuation of the lake at different periods of the year and are of value in connection with the irrigating of the Flathead Indian Reservation. The gage is of the ordinary staff type reading from 77 to 94 feet. It is nailed to the middle piling at the extreme end of the steamboat pier. Gage datum is 2,800 feet above sea level.

Daily gage height, in feet, of Flathead Lake at Polson, Mont., for 1908–9.

[A. K. Lusk, observer.]

Day.	Aug.	Sept.	Day.	Aug.	Sept.	Day.	Aug.	Sept.
1908.			1908.			1908.		
1		80.8	11		80.5	21		80.2
2		80.7	12		80.4	22		80.2
3		80.7	13		80.4	23	81.1	80.2
4		80.6	14		80.4	24	81.1	80.2
5		80.5	15		80.4	25	81.0	80.2
6		80.5	16		80.4	26	81.0	80.2
7		80.4	17		80.3	27	80.9	
8		80.4	18		80.3	28	80.9	
9		80.5	19		80.3	29	80.8	
10		80.5	20		80.2	30	80.8	
						31	80.8	

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.								
1		79.75	86.05			81.1	80.0	
2		79.8	86.4			81.1	80.0	
3		79.85	87.0	85.5		80.9		
4		79.8	87.65	88.3		80.9	80.0	
5		80.0	88.3	87.8			80.0	
6	79.15	80.15	88.85			80.7	79.9	
7	79.15	80.3	89.2	87.4		80.6	79.8	80.5
8	79.15	80.5	89.3			80.55		
9	79.15	80.6	89.25			80.55	79.9	
10		80.75	89.2			80.5	79.9	80.5
11			89.15			80.45		
12	79.05	81.05	89.0			80.4		
13	79.1	81.15	89.0			80.4		80.7
14	79.15	81.30	89.2	85.95		80.4	79.9	80.8
15	79.1	81.45	89.2				79.8	
16	79.1	81.55	89.3			80.4		
17	79.15	81.65	89.4			80.25	79.7	80.7
18	79.2	81.7	89.7	85.2	81.9	80.2	79.7	
19		81.8	89.8		81.7	80.25	79.7	80.6
20		81.85	90.05			80.1		80.7
21		82.0	90.2	84.65	81.5		79.6	
22		82.2	90.2		81.3	80.2	79.6	
23		82.45	90.2		81.4	80.2	79.7	80.9
24		82.7	90.2	84.0	81.4	80.2	79.6	
25		83.05	90.05		81.4	80.1		
26		83.65	89.75		81.4	80.1		
27	79.5	84.2	89.45				79.6	
28	79.7	84.7	89.2		81.2	80.05		
29	79.7	85.1	89.0				79.6	
30	79.7	85.5	88.7		81.15	80.0		81.75
31		85.8			81.1			

NOTE.—Add 2,800 feet for sea-level elevation. Ice conditions at this station not reported.

FLATHEAD RIVER NEAR POLSON, MONT.

This station was established July 23, 1907, at Michels Ferry, 8 miles below Polson. In the vicinity of the station the river has a fall of 240 feet in 6 miles. In 1909 the mean discharge was 11,800 second-feet, and as it is possible to equalize the flow, an enormous amount of power can be developed.

At the Newell dam site, located by the United States Reclamation Service, the stream flows from a narrow canyon whose bounding cliffs reach a great height. It is proposed to utilize the power for a pumping project to irrigate the lands of the Flathead Indian Reservation. There are no diversion canals taken from the river. The chain gage is located on the right bank just above the ferry. Its datum has not been changed since the station was first established, and estimates obtained at this station are excellent, as there is no appreciable change in the channel. Gaging conditions are little affected by ice, and good winter records are obtained. All measurements are made from car on ferry cable.

Discharge measurements of Flathead River near Polson, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	Raymond Richards	395	1,960	2.00	3,020
May 24	J. E. Stewart	360	3,820	6.56	13,900
June 18	Raymond Richards	500	6,820	13.20	56,300
July 30	do	473	4,560	7.65	19,600
Oct. 15	do	400	2,370	2.92	4,390

Daily gage height, in feet, of Flathead River near Polson, Mont., for 1909.

[P. Mitchell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.2	2.2	.....	1.7	2.8	9.8	12.15	7.35	4.25	3.25	2.5	5.3
2	2.2	2.2	.....	1.65	2.8	10.3	11.95	7.25	4.25	3.25	2.5	5.55
3	2.2	2.2	.....	1.6	2.85	10.65	11.75	7.15	4.25	3.25	2.55	5.45
4	2.2	2.1	.....	1.6	2.9	10.9	11.55	7.05	4.2	3.25	2.55	5.35
5	2.2	.....	.....	1.6	3.0	11.65	11.35	6.85	4.2	3.25	2.6	5.35
6	2.2	.....	1.7	1.6	3.55	12.5	11.15	6.75	4.2	3.15	2.6	5.3
7	2.2	.....	.....	1.6	3.8	12.8	10.95	6.65	4.2	3.15	2.7	5.25
8	2.3	.....	.....	1.6	3.95	12.9	10.85	6.7	4.2	3.15	2.8	5.15
9	2.3	2.0	.....	1.6	4.0	12.9	10.85	6.55	4.15	3.05	2.9	5.15
10	2.3	.....	.....	1.65	4.2	12.7	10.75	6.45	4.05	3.05	3.0	5.0
11	2.3	.....	1.6	1.65	4.4	12.6	10.65	6.35	4.05	3.05	3.2	5.0
12	2.4	.....	.....	1.65	4.6	12.6	10.55	6.25	3.95	3.05	3.3	5.05
13	2.4	.....	.....	1.65	4.7	12.6	10.45	6.15	3.75	2.85	3.4	5.05
14	2.4	1.8	.....	1.7	4.9	12.7	10.25	6.05	3.85	2.85	3.6	5.0
15	2.5	.....	.....	1.7	5.0	12.8	10.05	5.95	3.75	2.9	3.8	5.0
16	2.5	.....	1.6	1.7	5.3	12.9	10.05	5.85	3.7	2.85	4.0	4.95
17	2.5	.....	.....	1.7	5.4	13.0	9.85	5.75	3.65	2.85	4.25	4.95
18	2.5	.....	1.6	1.7	5.5	13.2	9.65	5.65	3.65	2.85	4.45	4.8
19	2.5	.....	.....	1.7	5.6	13.2	9.65	5.55	3.4	2.85	4.45	4.7
20	2.4	1.8	.....	2.0	5.7	13.5	9.05	5.5	3.4	2.85	4.5	4.6
21	2.4	.....	.....	2.0	5.7	13.7	7.95	5.35	3.4	2.7	4.6	4.5
22	2.35	.....	.....	2.0	5.9	13.75	8.35	5.4	3.4	2.7	4.7	4.55
23	2.35	.....	1.6	2.0	6.3	13.75	8.55	5.25	3.35	2.7	4.8	4.4
24	2.35	.....	.....	2.1	6.6	13.55	8.75	5.3	3.35	2.6	4.9	4.4
25	2.3	.....	.....	2.1	6.9	13.3	7.85	5.15	3.35	2.6	5.0	4.3
26	2.3	.....	.....	2.2	7.7	13.2	7.85	5.2	3.35	2.6	5.15	4.3
27	2.3	1.7	1.6	2.2	7.9	13.1	7.7	4.85	3.35	2.65	5.2	4.25
28	2.3	.....	.....	2.4	8.55	12.85	7.65	4.75	3.35	2.65	5.2	4.1
29	2.2	.....	.....	2.4	8.85	12.5	7.55	4.65	3.35	2.55	5.2	4.0
30	2.2	.....	.....	2.8	9.3	12.4	7.6	4.55	3.35	2.45	5.3	4.1
31	2.2	.....	1.6	.....	9.7	.....	7.45	4.35	.....	2.45	.....	4.4

NOTE.—Ice conditions not reported.

Daily discharge, in second-feet, of Flathead River near Polson, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3,130	3,130	2,620	2,620	3,880	31,100	47,600	18,200	6,800	4,880	3,770	9,700
2	3,130	3,130	2,620	2,580	3,880	34,600	46,200	17,800	6,800	4,880	3,770	10,500
3	3,130	3,130	2,620	2,530	3,950	37,000	44,800	17,200	6,800	4,880	3,840	10,200
4	3,130	3,020	2,620	2,530	4,020	38,800	43,400	16,800	6,680	4,880	3,840	9,850
5	3,130	3,000	2,620	2,530	4,160	44,000	42,000	15,800	6,680	4,880	3,900	9,850
6	3,130	2,980	2,620	2,530	4,990	50,000	40,600	15,300	6,680	4,720	3,900	9,700
7	3,130	2,950	2,600	2,530	5,400	52,100	39,200	14,900	6,680	4,720	4,040	9,550
8	3,250	2,930	2,580	2,530	5,660	52,800	38,400	15,100	6,680	4,720	4,180	9,250
9	3,250	2,910	2,570	2,530	5,750	52,800	38,400	14,500	6,570	4,560	4,330	9,250
10	3,250	2,870	2,550	2,580	6,160	51,400	37,800	14,100	6,360	4,560	4,480	8,800
11	3,250	2,830	2,530	2,580	6,610	50,700	37,000	13,700	6,360	4,560	4,800	8,800
12	3,370	2,790	2,530	2,580	7,090	50,700	36,400	13,300	6,150	4,560	4,970	8,950
13	3,370	2,750	2,530	2,580	7,340	50,700	35,600	12,900	5,760	4,260	5,140	8,950
14	3,370	2,710	2,530	2,620	7,870	51,400	34,300	12,500	5,960	4,260	5,490	8,800
15	3,490	2,710	2,530	2,620	8,150	52,100	33,100	12,100	5,760	4,330	5,860	8,800
16	3,490	2,710	2,530	2,620	9,020	52,800	33,100	11,700	5,670	4,260	6,250	8,650
17	3,490	2,710	2,530	2,620	9,330	53,500	31,900	11,300	5,580	4,260	6,800	8,650
18	3,490	2,710	2,530	2,620	9,650	54,900	30,700	10,900	5,580	4,260	7,280	8,210
19	3,490	2,710	2,530	2,620	9,970	54,900	30,700	10,500	5,140	4,260	7,280	7,930
20	3,370	2,710	2,530	2,910	10,300	57,000	27,100	10,300	5,140	4,260	7,400	7,660
21	3,370	2,700	2,530	2,910	10,300	58,400	21,200	9,850	5,140	4,040	7,660	7,400
22	3,310	2,680	2,530	2,910	11,000	58,800	23,200	10,000	5,140	4,040	7,930	7,530
23	3,310	2,670	2,530	2,910	12,500	58,800	24,200	9,550	5,060	4,040	8,210	7,150
24	3,310	2,660	2,530	3,020	13,700	57,400	25,300	9,700	5,060	3,900	8,500	7,150
25	3,250	2,650	2,530	3,020	14,900	55,600	20,800	9,250	5,060	3,900	8,800	6,910
26	3,250	2,630	2,530	3,130	18,700	54,900	20,800	9,400	5,060	3,900	9,250	6,910
27	3,250	2,620	2,530	3,130	19,700	54,200	20,000	8,360	5,060	3,970	9,400	6,800
28	3,130	2,620	2,530	3,370	23,200	52,400	19,800	8,070	5,060	3,970	9,400	6,460
29	3,130	.....	2,530	3,370	24,900	50,000	19,200	7,800	5,060	3,840	9,400	6,250
30	3,130	.....	2,530	3,880	27,700	49,300	19,500	7,530	5,060	3,700	9,700	6,460
31	3,130	.....	2,530	.....	30,400	.....	18,800	7,030	.....	3,700	.....	7,150

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to June 22, well defined below 18,000 second-feet. June 23 to Dec 31, well defined below 25,000 second-feet and fairly well defined above that point. Daily discharges interpolated for days on which gage heights are missing.

Monthly discharge of Flathead River near Polson, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	3,490	3,130	3,270	201,000	B.
February	3,130	2,620	2,810	156,000	B.
March	2,620	2,530	2,550	157,000	C.
April	3,880	2,530	2,780	165,000	B.
May	30,400	3,880	11,000	676,000	A.
June	58,800	31,100	50,800	3,020,000	B.
July	47,600	18,800	31,600	1,940,000	B.
August	18,200	7,030	12,100	744,000	A.
September	6,800	5,060	5,840	348,000	A.
October	4,880	3,700	4,320	266,000	A.
November	9,700	3,770	6,320	376,000	A.
December	10,500	6,250	8,330	512,000	A.
The year	58,800	2,530	11,800	8,560,000	

LITTLE BITTERROOT CREEK DRAINAGE BASIN.

DESCRIPTION.

Little Bitterroot Creek rises in Little Bitterroot Lake, near Marion, Mont., flows in a general southeasterly direction, and unites with Flathead River 12 miles north of Dixon. It is about 50 miles long, has numerous small tributaries, and drains an area of about 600 square miles. Several reservoir sites have been surveyed in the upper part of the stream, about 15 miles above the gaging station. Near Hubbart the stream has a sheer fall of about 50 feet and is bounded by high cliffs.

LITTLE BITTERROOT CREEK NEAR HUBBART, MONT.

The station on Little Bitterroot Creek was established April 22, 1909, in a box canyon just below the falls, 1½ miles from Hubbart post office and 15 miles south of Marion, but because of the poor gaging conditions the station was moved October 17 to a point about 1 mile above the former location, 1½ miles west of the ranch buildings of the Hubbart Cattle Co. and just above the canyon leading to the second fall of the Little Bitterroot.

Data obtained at this station will be used in connection with irrigation projects on the Flathead Indian Reservation.

A few small streams enter the creek above the station, but the principal source of water supply is Bitterroot Lakes. A few ditches divert water near the headwaters of the stream. The staff gage at the new station has a new datum. All measurements are made by wading. The stream freezes over at the gage in winter. Records of stream flow so far obtained are only fair.

Discharge measurements of Little Bitterroot Creek near Hubbart, Mont., in 1909.

Date.	Hydrographer.	Gage height.	Discharge.
		Feet.	*Sec.-ft.*
Apr. 22	Raymond Richards	2.21	50.7
May 26	J. E. Stewart	3.81	132
July 28	Raymond Richards	2.41	61.6
Oct. 17	do	1.68	11.6

NOTE.—All measurements above are referred to the lower station, old gage datum. The corresponding gage height at the new station for the measurement of Oct. 17 is 1.86 feet, new datum. Practically the same amount of water flows at both stations during the low-water period.

Daily gage height, in feet, of Little Bitterroot Creek near Hubbart, Mont., for 1909.

[William K. Hubbart, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					2.1			1.52	1.62
2		2.4				1.7	1.7		
3		2.5			2.1			1.52	1.67
4		2.5				1.7	1.7		
5					2.0			1.52	
6		2.55				1.7	1.7		
7					1.9			1.52	
8		2.55				1.7	1.7		
9					1.9			1.52	
10		2.6				1.7	1.7		
11					1.9			1.52	
12		2.75				1.7	1.7		
13					1.85			1.52	
14		2.8				1.7	1.7		
15					1.8			1.67	
16		2.9				1.7	1.52		
17					1.8			1.77	
18		3.0				1.7	1.52		
19					1.8			1.97	
20		3.15				1.7	1.52		
21					1.75			2.02	
22	2.2	3.15				1.7	1.52		
23					1.7			2.17	
24	2.25					1.7	1.52		
25					1.7			1.77	
26	2.4	3.8				1.7	1.52		
27					1.75				
28	2.45			2.4		1.7	1.52	1.67	
29					1.7				
30	2.3			2.2		1.7	1.52	1.62	
31					1.7				

NOTE.—Beginning Oct. 16 all gage heights referred to new gage. Ice conditions not reported.

Daily discharge, in second-feet, of Little Bitterroot Creek near Hubbart, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		58			40	13	13	13	20
2		62			40	13	13	13	22
3		70			40	13	13	13	23
4		70			36	13	13	13	
5		72			33	13	13	13	
6		74			30	13	13	13	
7		74			26	13	13	13	
8		74			26	13	13	13	
9		76			26	13	13	13	
10		78			26	13	13	13	
11		84			26	13	13	13	
12		89			24	13	13	13	
13		92			23	13	13	13	
14		94			22	13	13	18	
15		98			20	13	13	23	
16		102			20	13	13	26	
17		106			20	13	13	29	
18		110			20	13	13	36	
19		116			20	13	13	42	
20		122			18	13	13	44	
21		122			16	13	13	45	
22	48	122			14	13	13	50	
23	50				13	13	13	56	
24	51				13	13	13	42	
25	56				13	13	13	29	
26	62				14	13	13	27	
27	64				16	13	13	25	
28	66			62	15	13	13	23	
29	60				13	13	13	22	
30	55			48	13	13	13	20	
31					13		13		

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Little Bitterroot Creek near Hubbart, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 22-30	66	48	57	1,020	B.
May 1-22	122	58	89	3,880	B.
August	40	13	22	1,350	B.
September	13	13	13	774	B.
October	13	13	13	799	B.
November	56	13	24	1,430	B.
The period				9,250	

LITTLE BITTERROOT CREEK NEAR DAYTON, MONT.

This gaging station, which was established April 18, 1908, at McDonald's ranch, is located near Dayton, Mont., 12 miles north of the Warm Springs, on the Flathead Indian Reservation. The records will be used by the United States Reclamation Service to determine the amount of water available for irrigating portions of Little Bitterroot Valley. Above the station a few small tributaries add to the volume of the creek and several ditches take water from it. The water is not all appropriated.

A staff gage is nailed to a piling of the foot bridge just back of the observer's house. At most stages measurements can be made to an advantage from this foot bridge.

Discharge measurements of Little Bitterroot Creek near Dayton, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 22	Raymond Richards	22	41.3	5.20	65.4
May 25	J. E. Stewart	27	80.2	6.52	174
July 28	Raymond Richards	28	54.4	5.57	93.4
Oct. 16	do	22	24.8	4.28	20.7

Daily gage height, in feet, of Little Bitterroot Creek near Dayton, Mont., for 1909.

[A. P. McDonald, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		5.0	5.5	6.25	5.0	4.8	4.3	4.3	4.3	4.8
2		4.95	5.4	6.45	4.9	4.75	4.35	4.3	4.35	4.7
3		4.9	5.5	6.65	4.85	4.7	4.4	4.3	4.7	4.9
4		5.0	6.35	6.4	4.8	4.7	4.35	4.25	4.7	4.8
5		5.0	6.25	6.4	4.8	4.65	4.3	4.25	4.65	4.7
6		5.1	6.2	6.3	5.3	4.6	4.3	4.3	4.5	4.7
7		4.9	5.9	6.3	5.15	4.6	4.3	4.3	4.4	4.7
8		4.8	5.75	6.25	5.0	4.55	4.25	4.25	4.35	4.7
9		5.0	5.6	6.1	5.0	4.5	4.25	4.25	4.35	4.7
10		5.1	5.8	5.8	4.95	4.5	4.3	4.25	4.4	4.7
11		5.15	6.0	5.75	5.0	4.5	4.3	4.25	4.4	4.7
12		4.9	5.8	5.75	4.95	4.45	4.3	4.25	4.35	4.7
13		5.1	5.75	5.8	4.85	4.45	4.3	4.25	4.35	4.75
14		5.3	5.8	5.7	4.8	4.45	4.3	4.25	4.35	4.7
15		5.25	5.9	5.65	4.75	4.4	4.25	4.25	4.35	4.7

Daily gage height, in feet, of Little Bitterroot Creek near Dayton, Mont., in 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	5.3	5.95	5.9	4.7	4.4	4.25	4.25	4.3	4.7
17	.....	5.3	6.0	6.2	4.65	4.4	4.25	4.3	4.3	4.65
18	.....	5.3	6.1	6.4	4.6	4.35	4.25	4.25	4.4	4.6
19	4.75	5.25	6.0	6.5	4.55	4.35	4.25	4.25	4.55	4.6
20	4.7	5.35	5.9	6.4	4.6	4.35	4.3	4.3	4.8	4.6
21	4.6	5.3	6.1	6.2	4.55	4.3	4.4	4.3	4.75	4.6
22	4.75	5.2	6.3	6.1	4.5	4.3	4.3	4.3	4.6	4.55
23	4.5	5.2	6.3	6.0	4.5	4.3	4.3	4.3	5.1	.....
24	4.85	5.25	6.3	6.0	4.5	4.35	4.3	4.3	5.8	.....
25	4.8	5.3	6.4	5.8	4.45	4.3	4.3	4.3	5.5	.....
26	4.75	5.4	9.0	5.6	4.9	4.3	4.25	4.25	5.25	.....
27	4.7	5.6	7.3	5.5	5.0	4.25	4.25	4.25	5.0	.....
28	4.8	5.7	7.2	5.3	5.3	4.3	4.2	4.25	5.0	.....
29	4.85	5.5	7.0	5.2	5.0	4.3	4.3	4.25	4.9	.....
30	4.9	5.5	6.8	5.1	4.9	4.3	4.4	4.25	4.9	.....
31	4.8	.....	6.5	.....	4.8	4.3	.....	4.25	.....	.....

NOTE.—Probable ice conditions January and February and part of March, Dec. 3–31, 1909. The creek was frozen over Dec. 23.

Daily discharge, in second-feet, of Little Bitterroot Creek near Dayton, Mont., for 1909.

Day.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	53	86	150	53	42	21	21	21	42
2	.....	50	79	170	47	40	22	21	22	37
3	.....	47	86	190	44	37	24	21	37	.....
4	.....	53	160	165	42	37	22	20	37	.....
5	.....	53	150	165	42	34	21	20	34	.....
6	.....	59	146	155	72	32	21	21	28	.....
7	.....	47	119	155	62	32	21	21	24	.....
8	.....	42	106	150	53	30	20	20	22	.....
9	.....	53	94	137	53	28	20	20	22	.....
10	.....	59	110	110	50	28	21	20	24	.....
11	.....	62	128	106	53	28	21	20	24	.....
12	.....	47	110	106	50	26	21	20	22	.....
13	.....	59	106	110	44	26	21	20	22	.....
14	.....	72	110	102	42	26	21	20	22	.....
15	.....	68	119	98	40	24	20	20	22	.....
16	.....	72	124	119	37	24	20	20	21	.....
17	.....	72	128	146	34	24	20	21	21	.....
18	.....	72	137	165	32	22	20	20	24	.....
19	40	68	128	175	30	22	20	20	30	.....
20	37	76	119	165	32	22	21	21	42	.....
21	32	72	137	146	30	21	24	21	40	.....
22	40	65	155	137	28	21	21	21	32	.....
23	28	65	155	128	28	21	21	21	59	.....
24	44	68	155	128	28	22	21	21	110	.....
25	42	72	165	110	26	21	21	21	86	.....
26	40	79	225	94	47	21	20	20	68	.....
27	37	94	258	86	53	20	20	20	53	.....
28	42	102	247	72	72	21	18	20	53	.....
29	44	86	225	65	53	21	21	20	47	.....
30	47	86	205	59	47	21	24	20	47	.....
13	42	.....	175	.....	42	21	.....	20	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Little Bitterroot Creek near Dayton, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Mar. 19–31	47	28	39.6	1,020	B
April	102	42	65.8	3,920	A
May	258	79	143	8,790	B
June	190	59	129	7,680	A
July	72	26	44.1	2,710	A
August	42	20	26.3	1,620	B
September	24	18	21.0	1,250	B
October	21	20	20.4	1,250	B
November	110	21	37.2	2,210	B
The period				30,400	

CROW CREEK DRAINAGE BASIN.

DESCRIPTION.

Crow Creek rises in the eastern part of the Flathead Indian Reservation and flows in a generally southwesterly direction, entering Flathead River about 3 miles below the mouth of the Little Bitterroot.

CROW CREEK NEAR RONAN, MONT.

This station, which was established September 21, 1906, for the purpose of obtaining data for use in connection with a project to irrigate the Flathead Indian Reservation, is located about 4 miles south of Ronan, Mont., at the highway bridge on the stage road from St. Ignatius to Ronan. Investigations in connection with this project have been carried on by the United States Reclamation Service since the summer of 1907.

No important tributaries enter the creek above the station and no water is diverted. Mud and Spring Creeks empty into Crow Creek several miles below. The current is very sluggish and during the winter months the discharge is affected by ice. A staff gage is nailed to the bridge pier on the left bank. Its datum has not been changed since the station was established.

This station affords good conditions for obtaining accurate discharge data as the channel does not change appreciably except during flood stages.

High-water measurements are made from the bridge, but in low water better results may be obtained by wading.

Discharge measurements of Crow Creek near Ronan, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	Raymond Richards	27	14.8	0.94	15.3
May 27	J. E. Stewart	42	116	4.29	204
June 19	Raymond Richards	44	189	5.50	325
July 25	do	35	36.5	2.06	71.8
Oct. 14	do	29	16.6	.99	21.2

Daily gage height, in feet, of Crow Creek near Ronan, Mont., for 1909.

[A. McIntyre, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.75	4.4	1.3	1.1	1.25	0.9	1.1
2	1.6	5.35	4.2	1.15	1.1	1.15	1.0	1.05
3	1.7	5.95	3.5	1.05	1.15	1.1	2.25	.....
4	1.65	5.95	3.85	1.15	1.25	1.1	3.4	.....
5	1.5	5.8	3.7	1.2	1.3	1.1	3.15	.....
6	1.4	5.4	3.85	1.3	1.2	1.1	2.55	.....
7	1.3	4.75	4.75	1.3	1.1	1.1	1.9	.....
8	1.3	4.05	3.95	.....	1.1	1.1	1.8	.....
9	1.3	3.85	3.65	.....	1.1	1.1	1.7	.....
10	1.4	3.65	3.3	1.2	1.1	1.1	1.7	.....
11	1.4	3.75	.....	1.15	1.1	1.0	1.8	.....
12	1.5	4.4	4.25	1.2	1.1	1.0	1.8	.....
13	1.4	4.7	3.80	1.2	1.0	1.0	1.75	.....
14	1.4	4.85	3.35	1.25	1.0	1.0	1.7	.....
15	1.4	5.15	3.05	1.3	1.0	1.0	.....	.....
16	1.6	5.8	2.95	1.35	1.0	1.0	.....	.....
17	1.7	5.8	2.8	1.4	1.0	.9	.....	.....
18	1.6	5.2	2.65	1.4	1.0	.9	.....	.....
19	1.65	5.9	2.55	1.3	1.1	.9	1.4	.....
20	1.8	6.55	2.4	1.3	1.1	.9	1.35	.....
21	2.05	6.65	2.5	1.3	1.15	.9	1.3	.....
22	2.1	5.9	2.4	1.3	1.1	.9	1.4	.....
23	2.1	5.2	2.25	1.2	1.1	.9	1.5	.....
24	2.25	4.95	2.15	1.2	1.0	.9	1.6	.....
25	2.7	4.55	2.1	1.1	1.05	.9	1.55	.....
26	3.35	4.8	2.05	1.1	1.0	.9	1.5	.....
27	4.25	4.3	1.9	1.1	1.0	.9	1.4	.....
28	4.9	4.3	1.8	1.1	1.0	.9	1.4	.....
29	5.05	4.25	1.65	1.2	1.25	.9	1.3	.....
30	4.65	4.0	1.45	1.2	1.3	.9	1.2	.....
31	4.0	.....	1.4	1.1	.....	.9	.....	.....

NOTE.—The creek reported frozen Nov. 15 to 18 and Dec. 3 to 19. It was probably frozen for remainder of year.

Daily discharge, in second-feet, of Crow Creek near Ronan, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	40	240	232	34	26	32	18	26
2	40	288	216	28	26	28	22	24
3	45	336	165	24	28	26	82	.....
4	42	336	190	28	32	26	158	.....
5	36	324	179	30	34	26	140	.....
6	32	292	190	34	30	26	100	.....
7	28	240	260	34	26	26	62	.....
8	28	190	196	34	26	26	57	.....
9	28	176	176	30	26	26	52	.....
10	32	162	151	30	26	26	52	.....
11	32	168	186	28	26	22	57	.....
12	36	214	220	30	26	22	57	.....
13	32	236	185	30	22	22	54	.....
14	32	248	154	32	22	22	52	.....
15	32	272	134	34	22	22	49	.....
16	40	324	126	36	22	22	46	.....
17	45	324	116	38	22	18	43	.....
18	40	276	106	38	22	18	40	.....
19	42	354	100	34	26	18	38	.....
20	50	417	91	34	26	18	36	.....
21	62	426	97	34	28	18	34	.....
22	65	354	91	34	26	18	38	.....
23	65	296	82	30	26	18	42	.....
24	74	276	76	30	22	18	47	.....
25	101	324	73	26	24	18	44	.....
26	140	264	70	26	22	18	42	.....
27	204	224	62	26	22	18	38	.....
28	252	224	57	26	22	18	38	.....
29	264	220	50	30	32	18	34	.....
30	232	200	40	30	34	18	30	.....
31	186	.....	38	26	.....	18	.....	.....

NOTE.—These discharges are based on rating tables applicable as follows:
May 2 to June 18, and June 19 to Dec. 2, both fairly well defined between 15 and 220 second-feet.
Discharges, July 11, Aug. 8 to 10, and Nov. 15 to 18, interpolated.

Monthly discharge of Crow Creek near Ronan, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	264	28	76.7	4,720	B.
June	426	162	274	16,300	B.
July	232	38	133	8,180	B.
August	38	24	30.9	1,900	B.
September	34	22	25.8	1,540	B.
October	32	18	21.6	1,330	B.
November	158	18	53.4	3,180	B.
The period				37,200	

MUD CREEK NEAR RONAN, MONT.

Mud Creek rises about 6 miles southeast of Flathead Lake and flows southwestward into Crow Creek.

The gaging station was established April 17, 1908, on Jeffrey's ranch, 3 miles northwest of Ronan, Mont., to obtain data for use by the United States Reclamation Service on the Flathead project.

The staff gage is nailed to a post driven in the ground just above a foot log from which measurements are made. The Pablo ditch, which takes water from the creek about 200 feet below the gage, is the only diversion of importance.

As the velocity is sluggish it is difficult to obtain accurate results.

Discharge measurements of Mud Creek near Ronan, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	Raymond Richards	5.5	9.4	2.70	4.9
May 24	J. E. Stewart	7.0	15.0	2.68	3.5
June 18	Raymond Richards	6.0	17.8	3.11	8.5
July 25	do	5.7	17.7	3.41	15.7
Oct. 15	do	6.0	17.2	2.93	4.9

Daily gage height, in feet, of Mud Creek near Ronan, Mont., for 1909.

[F. O. Jeffrey, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.35	2.9	3.0	4.0	3.55	3.5	2.9	2.95	2.85
2	2.6	2.35	2.9	3.05	4.0	3.55	3.5	2.9	2.95	2.85
3	2.6	2.3	2.9	3.1	3.9	3.4	3.4	2.9	2.95	2.85
4	2.7	2.3	2.95	3.15	4.0	3.35	3.4	2.9	2.95	2.8
5	2.65	2.3	2.95	3.2	4.0	3.35	3.5	2.9	2.95	2.8
6	2.65	2.3	2.95	3.1	4.1	3.35	3.5	2.95	2.95	2.8
7	2.7	2.25	2.95	3.0	4.1	3.3	3.5	2.95	2.9	2.8
8	2.8	2.25	2.95	3.0	4.15	3.3	3.4	2.95	2.9	2.8
9	2.8	2.3	2.95	2.7	4.15	3.2	3.4	2.95	2.9	2.8
10	2.9	2.3	2.8	2.6	4.2	3.2	3.4	3.0	2.85	2.8
11	2.9	2.4	2.8	2.5	4.3	3.1	3.0	3.0	2.85	2.8
12	3.0	2.4	2.7	2.4	4.3	3.1	3.0	3.0	2.85	2.8
13	3.0	2.4	2.7	2.4	4.25	3.7	3.0	3.0	2.85	2.75
14	3.1	2.45	2.7	2.35	4.25	3.7	3.0	3.0	2.9	2.75
15	3.1	2.45	2.7	3.0	4.25	3.5	3.0	3.0	2.9	2.75

Daily gage height in feet of Mud Creek near Ronan, Mont., for 1909—Continued.

[F. O. Jeffrey, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.1	2.5	2.5	3.0	4.25	3.5	3.0	3.0	2.9	2.7
17	2.85	2.5	2.7	3.1	4.25	3.5	3.0	3.0	2.9	2.7
18	2.75	2.6	2.7	3.5	3.90	3.5	3.0	3.0	2.85	2.7
19	2.75	2.55	2.75	3.5	3.9	3.5	3.0	3.0	2.85	2.7
20	2.65	2.6	2.75	4.0	3.8	3.5	3.0	3.0	2.85	2.7
21	2.6	2.65	2.8	4.1	3.8	3.5	3.0	3.0	2.85	2.7
22	2.6	2.65	2.8	4.1	3.7	3.4	3.0	3.0	2.85	2.75
23	2.6	2.7	2.8	4.5	3.65	3.4	3.0	3.0	2.9	2.75
24	2.55	2.7	2.8	4.1	3.6	3.4	3.0	3.0	2.9	2.75
25	2.55	2.85	2.8	4.1	3.55	3.4	3.0	3.0	2.85	2.75
26	2.5	2.85	2.8	4.1	3.55	3.4	3.0	3.0	2.85	2.75
27	2.4	2.85	2.8	4.5	3.55	3.4	3.0	3.0	2.85	2.75
28	2.35	2.8	2.8	4.5	3.55	3.4	3.0	3.0	2.85	2.7
29	2.3	2.75	2.8	4.5	3.55	3.4	2.95	3.0	2.9	2.7
30	2.3	2.8	2.9	4.5	3.55	3.4	2.95	3.0	2.9	2.7
31	2.3	.....	3.0	.....	3.55	3.5	.....	3.0	.....	2.7

Daily discharge, in second-feet, of Mud Creek near Ronan, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	1.8	5.7	6.9	26	17	16	5.7	6.3	5.2
2	3.1	1.8	5.7	7.6	26	17	16	2.9	6.3	5.2
3	3.1	1.7	5.7	8.3	24	14	14	2.9	6.3	5.2
4	3.9	1.7	6.3	9.2	26	13	14	2.9	6.3	4.7
5	3.5	1.7	6.3	10	26	13	16	2.9	6.3	4.7
6	3.5	1.7	6.3	8.3	28	13	16	6.3	6.3	4.7
7	3.9	1.6	6.3	6.9	28	12	16	6.3	5.7	4.7
8	4.7	1.6	6.3	6.9	29	12	14	6.3	5.7	4.7
9	4.7	1.7	6.3	3.9	29	10	14	6.3	5.7	4.7
10	5.7	1.7	4.7	3.1	30	10	14	6.9	5.2	4.7
11	5.7	2.0	4.7	2.5	33	8.3	6.9	6.9	5.2	4.7
12	6.9	2.0	3.9	2.0	33	8.3	6.9	6.9	5.2	4.7
13	6.9	2.0	3.9	2.0	32	20	6.9	6.9	5.2	4.3
14	8.3	2.2	3.9	1.8	32	20	6.9	6.9	5.7	4.3
15	8.3	2.2	3.9	6.9	32	16	6.9	6.9	5.7	4.3
16	8.3	2.5	2.5	6.9	32	16	6.9	6.9	5.7	3.9
17	5.2	2.5	3.9	8.3	32	16	6.9	6.9	5.7	3.9
18	4.3	3.1	3.9	16	24	16	6.9	6.9	5.2	3.9
19	4.3	2.8	4.3	16	24	16	6.9	6.9	5.2	3.9
20	3.5	3.1	4.3	26	22	16	6.9	6.9	5.2	3.9
21	3.1	3.5	4.7	28	22	16	6.9	6.9	5.2	3.9
22	3.1	3.5	4.7	28	20	14	6.9	6.9	5.2	4.3
23	3.1	3.9	4.7	39	19	14	6.9	6.9	5.7	4.3
24	2.8	3.9	4.7	28	18	14	6.9	6.9	5.7	4.3
25	2.8	5.2	4.7	28	17	14	6.9	6.9	5.2	4.3
26	2.5	5.2	4.7	28	17	14	6.9	6.9	5.2	4.3
27	2.0	5.2	4.7	39	17	14	6.9	6.9	5.2	4.3
28	1.8	4.7	4.7	39	17	14	6.9	6.9	5.2	3.9
29	1.7	4.3	4.7	39	17	14	6.3	6.9	5.7	3.9
30	1.7	4.7	5.7	39	17	14	6.3	6.9	5.7	3.9
31	1.7	.....	6.9	.....	17	16	.....	6.9	.....	3.9

NOTE.—These discharges are based on a rating curve that is fairly well defined between discharges 3 and 16 second-feet.

Monthly discharge of Mud Creek near Ronan, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	8.3	1.7	4.10	252	C.
April	5.2	1.6	2.85	170	C.
May	6.9	2.5	4.96	305	C.
June	39	1.8	16.5	982	B.
July	33	17	24.7	1,520	B.
August	20	8.3	14.2	873	B.
September	16	6.3	9.56	569	C.
October	6.9	2.9	6.27	386	C.
November	6.3	5.2	5.60	333	C.
December	5.2	3.9	4.37	269	C.
The period				5,660	

MISSION CREEK DRAINAGE BASIN.

DESCRIPTION.

Mission Creek rises in the western slope of the Mission Range and flows in a general northwesterly direction into Flathead River about 3 miles above Dixon. The only important tributaries are Dry and Post creeks, which enter Mission Creek just above St. Ignatius.

MISSION CREEK NEAR ST. IGNATIUS, MONT.

This station, which is located opposite the home of A. A. Booke, about 1 mile downstream from St. Ignatius, was established September 21, 1906, to obtain data for use in connection with water-power and irrigation projects. Two or three small ditches, which are used to irrigate about 800 acres near St. Ignatius Mission, divert water above the gage.

A few miles above the station where the stream flows out from mountains it has a fall of nearly 1,000 feet and affords an excellent opportunity for water-power development.

The staff gage was washed out July 5, 1907, and on July 24 a new gage was installed a short distance downstream and with a datum 0.30 foot lower; on January 25, 1908, this gage was lowered 0.39 foot. The gage was again destroyed by high water June 7, 1908, and was replaced June 26, 20 feet farther downstream at a different datum. Discharge measurements are made by wading near the gage.

The current is swift and the records of flow are but little affected by ice during the winter months. The channel shifts during high water, but at ordinary stages the conditions for obtaining accurate discharge data are good.

Discharge measurements of Mission Creek near St. Ignatius, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	Raymond Richards	20	9.9	2.38	14.1
May 23	J. E. Stewart	24	21.4	2.54	33.9
28	do	34	52	3.17	214
June 19	Raymond Richards	47	79	3.76	327
July 24	do	29	33.3	2.96	140
Oct. 14	do	24	18.2	2.44	48.3

Daily gage height, in feet, of Mission Creek near St. Ignatius, Mont., for 1909.

[Mrs. Annie Booke, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.45	2.4	2.4	2.4	2.95	3.7	2.85	2.5	.....	2.35	2.25
2	2.5	2.45	2.4	2.4	.....	3.45	.....	2.8	2.5	.....	2.35	2.25
3	2.5	2.45	2.4	2.4	2.4	3.75	3.65	2.8	2.6	.....	2.35	2.25
4	2.5	2.45	2.4	2.4	2.4	3.5	.....	2.7	.....	2.45	2.4	2.25
5	2.5	2.45	2.4	2.4	2.4	3.5	3.6	2.7	.....	2.45	2.45	.....
6	2.5	2.45	2.4	2.4	2.45	.....	3.4	2.7	2.5	2.45	2.5	2.2
7	2.5	.....	.....	2.4	2.45	3.35	3.3	2.7	2.5	2.45	.....	2.2
8	.....	.....	2.4	2.4	2.45	3.15	3.3	.....	2.5	2.45	2.45	2.2
9	.....	2.45	2.4	2.4	.....	3.15	3.3	2.7	2.45	2.45	2.45	2.2
10	.....	2.45	2.4	2.4	2.45	3.05	.....	2.7	2.45	2.45	2.45	2.2
11	2.5	2.45	2.4	2.4	2.45	3.0	3.2	2.7	2.45	2.45	2.45	.....
12	.....	2.45	2.4	2.4	2.45	3.05	3.3	2.7	2.45	2.45	2.45	2.2
13	2.5	2.45	2.4	2.4	2.45	3.1	3.2	2.7	2.45	2.45	2.4	2.2
14	2.5	2.45	2.4	2.4	2.45	3.25	3.25	2.7	2.4	2.45	.....	2.2
15	2.5	2.4	2.4	2.4	2.45	3.35	3.2	.....	2.4	2.45	2.25	2.2
16	2.5	2.4	2.4	2.4	.....	3.7	3.1	2.65	2.4	2.45	2.35	2.2
17	.....	2.4	2.4	2.4	2.45	3.75	3.1	2.6	2.4	2.45	2.35	2.2
18	2.55	2.4	2.4	.....	2.45	3.75	3.1	2.6	2.4	2.4	2.35	2.25
19	2.55	2.4	.....	2.35	2.45	3.75	3.05	2.6	.....	2.35	2.35	.....
20	2.7	2.4	2.4	2.35	2.45	4.2	3.0	2.65	2.4	2.35	2.35	2.15
21	2.55	2.4	2.4	2.35	2.5	4.55	3.0	2.65	2.4	2.35	.....	2.15
22	2.5	2.4	.....	2.35	2.5	4.4	3.0	.....	2.4	2.35	2.25	2.15
23	2.5	2.4	2.4	2.35	2.5	3.7	3.0	2.55	2.4	2.35	2.25	2.15
24	.....	2.4	2.4	2.35	2.55	3.5	2.95	2.55	2.4	2.35	2.25	2.15
25	2.5	2.4	2.4	.....	2.8	3.4	.....	2.55	2.4	2.35	2.35	.....
26	2.5	2.4	2.4	2.35	2.85	3.4	2.9	2.55	.....	2.35	2.35	.....
27	2.5	2.4	2.4	2.35	3.1	3.4	2.9	2.55	2.4	2.35	.....	2.15
28	2.5	2.4	2.4	2.4	3.15	3.3	3.1	2.55	2.45	2.35	.....	2.15
29	2.45	.....	2.4	.....	3.05	3.4	3.1	.....	2.45	2.35	2.25	2.15
30	2.45	.....	2.4	2.4	.....	3.6	2.95	.....	2.55	2.35	2.25	2.15
31	.....	.....	2.4	.....	2.8	.....	2.9	.....	.....	2.35	.....	2.15

NOTE.—Creek partly frozen over Jan. 3 to 14.

Daily discharge, in second-feet, of Mission Creek near St. Ignatius, Mont., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	28	22	16	16	16	151	311	118	58	63	40	30
2	28	22	16	16	16	266	306	108	58	60	40	30
3	28	22	16	16	16	340	300	108	73	56	40	30
4	28	22	16	16	16	278	293	90	68	52	45	30
5	28	22	16	16	16	278	287	90	63	52	52	28
6	28	22	16	16	22	260	238	90	58	52	58	25
7	28	22	16	16	22	242	214	90	58	52	55	25
8	28	22	16	16	22	194	214	90	58	52	52	25
9	28	22	16	16	22	194	214	90	52	52	52	25
10	28	22	16	16	22	172	202	90	52	52	52	25
11	28	22	16	16	22	162	191	90	52	52	52	25
12	28	22	16	16	22	172	214	90	52	52	52	25
13	28	22	16	16	22	183	191	90	52	52	45	25
14	28	22	16	16	22	217	202	90	95	52	38	25
15	28	16	16	16	22	242	191	86	45	52	30	25

Daily discharge, in second-feet, of Mission Creek near St. Ignatius, Mont., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	28	16	16	16	22	327	168	82	45	52	40	25
17	32	16	16	16	22	340	168	73	45	52	40	25
18	36	16	16	14	22	340	168	73	45	45	40	30
19	36	16	16	13	22	340	158	73	45	40	40	25
20	58	16	16	13	22	441	147	82	45	40	40	21
21	36	16	16	13	28	602	147	82	45	40	35	21
22	28	16	16	13	28	493	147	74	45	40	30	21
23	28	16	16	13	28	311	147	66	45	40	30	21
24	28	16	16	13	36	263	137	66	45	40	30	21
25	28	16	16	13	83	238	132	66	45	40	40	21
26	28	16	16	13	97	238	127	66	45	40	40	21
27	28	16	16	13	186	238	127	66	45	40	35	21
28	28	16	16	16	207	214	168	66	52	40	35	21
29	22	.....	16	16	172	238	168	64	52	40	30	21
30	22	.....	16	16	146	287	137	61	66	40	30	21
31	22	.....	16	.....	121	.....	127	58	.....	40	.....	21

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to May 23, fairly well defined. May 24 to June 18, indirect method for shifting channels used. June 19 to Dec. 31 fairly well defined. Daily discharges interpolated for days when gage heights are missing.

Monthly discharge of Mission Creek near St. Ignatius, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	58	22	29.3	1,800	C.
February	22	16	19.0	1,060	C.
March	16	16	16.0	984	C.
April	16	13	15.0	893	B.
May	207	16	49.7	3,060	B.
June	602	151	275	16,400	C.
July	311	127	191	11,700	C.
August	118	58	81.6	5,020	C.
September	73	45	51.8	3,080	C.
October	63	40	47.5	2,920	C.
November	58	30	41.3	2,460	C.
December	30	21	24.4	1,500	C.
The year	602	13	70.5	50,900	

DRY CREEK NEAR ST. IGNATIUS, MONT.

Dry Creek rises on the western slopes of the Mission Range, in the southeastern part of the Flathead Reservation, and flows northwestward into Mission Creek.

The gaging station, which was established April 16, 1908, to obtain data for use in connection with a project to irrigate land in Mission Creek Valley, is located opposite Fellsman's ranch, about 3½ miles southeast of St. Ignatius. The creek is the outlet of St. Marys Lake, which will be used as a reservoir to store the entire flow of the stream.

The current is swift. The bed of the stream is composed of coarse gravel and bowlders. Measurements are made by wading near the staff gage. No change in gage datum has been made. At low and medium stages none of the water reaches Mission Creek, and during

the winter and early spring ceases to flow at the gage. Above the station one small ditch diverts water for irrigation. The only tributary is a small creek which enters from the right a short distance below the station. The conditions are fair for obtaining accurate discharge data.

Discharge measurements of Dry Creek near St. Ignatius, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 28	J. E. Stewart	14	16.8	0.96	42.2
June 19	Raymond Richards	15	26.4	1.60	107
July 24	do	14	12.0	.79	28.6
Oct. 14	do	10	4.8	.35	5.7

Daily gage height, in feet, of Dry Creek near St. Ignatius, Mont., for 1909.

[Henry Fellsman, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.0	1.5	0.8	0.2	0.25	.....	16	0.1	1.5	0.8	0.4	0.2	0.3	0.2
2	.....	1.2	1.5	.75	.2	.25	.....	17	.2	1.8	.8	.35	.2	.3	.....
3	.....	1.4	1.5	.7	.3	.25	.....	18	.....	1.9	.9	.35	.2	.3	.3
4	.....	1.5	1.4	.6	.3	.25	.....	19	.....	1.9	.9	.3	.2	.2	.1
5	.....	1.5	1.2	.5	.3	.3	0.2	20	.....	1.9	.9	.3	.2	.2	.....
6	.....	1.4	1.5	.5	.25	.3	.4	21	.....	1.8	.9	.3	.2	.25	.....
7	.....	1.3	1.5	.5	.2	.3	.4	22	.3	1.6	.9	.3	.2	.1	.....
8	.....	1.0	1.4	.5	.2	.2	.3	23	.4	1.3	.8	.3	.15	.1	.....
9	0.05	1.0	1.0	.5	.2	.1	.1	24	.45	1.2	.8	.3	.1	.....	.....
10	.05	.9	1.2	.6	.2	.15	.1	25	.5	1.1	.8	.3	.1	.4	.....
11	.1	.85	1.0	.5	.2	.1	.....	26	.65	1.1	.8	.35	.15	.4	.....
12	.1	.85	1.0	.5	.2	.2	.....	27	.85	1.1	.8	.3	.2	.4	.....
13	.05	.9	1.0	.45	.2	.3	.....	28	1.0	1.1	.9	.3	.2	.4	.....
14	.05	1.0	.9	.4	.2	.3	.....	29	.95	1.2	.9	.25	.2	.35	.....
15	.....	1.3	.9	.4	.2	.3	.....	30	.9	1.2	.8	.2	.25	.35	.....
								31	.95	.....	.8	.2	.....	.2	.....

NOTE.—Creek dry May 15, 18 to 21; Oct. 24; Nov. 1 to 4, 11 to 15, 17, 20 to 30.

Daily discharge, in second-feet, of Dry Creek near St. Ignatius, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	44	95	29	2.2	3.2	.....	16	1.0	95	29	7	2.2	4.2	2.2
2	.....	63	95	26	2.2	3.2	.0	17	2.2	131	29	5.6	2.2	4.2	.0
3	.....	84	95	22	4.2	3.2	.0	18	.0	144	36	5.6	2.2	4.2	4.2
4	.....	95	84	16	4.2	3.2	.0	19	.0	144	36	4.2	2.2	2.2	1.0
5	.....	95	63	11	4.2	4.2	2.2	20	.0	144	36	4.2	2.2	2.2	.....
6	.....	84	95	11	3.2	4.2	7.0	21	.0	131	36	4.2	2.2	3.2	.....
7	.....	73	95	11	2.2	4.2	7.0	22	4.2	107	36	4.2	2.2	1.0	.....
8	.....	44	84	11	2.2	2.2	4.2	23	7.0	73	29	4.2	1.6	1.0	.....
9	0.5	44	44	11	2.2	1.0	1.0	24	9.0	63	29	4.2	1.0	.0	.....
10	.5	36	63	16	2.2	1.6	1.0	25	11	53	29	4.2	1.0	7	.....
11	1.0	32	44	11	2.2	1.0	.0	26	19	53	29	5.6	1.6	7	.....
12	1.0	32	44	11	2.2	2.2	.0	27	32	53	29	4.2	2.2	7	.....
13	.5	36	44	9	2.2	4.2	.0	28	44	53	36	4.2	2.2	7	.....
14	.5	44	36	7	2.2	4.2	.0	29	40	63	36	3.2	2.2	5.6	.....
15	.0	73	36	7	2.2	4.2	.0	30	36	63	29	2.2	3.2	5.6	.....
								31	40	.....	29	2.2	.....	2.2	.....

NOTE.—These discharges are based on a rating curve that is well defined between discharges 4 and 110 second-feet. The creek was dry May 15, 18 to 21; Oct. 24; Nov. 1 to 4, 11 to 15, 17, 20 to 30.

Monthly discharge of Dry Creek near St. Ignatius, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 9-31	44	0.0	10.8	492	D.
June	144	32	75.0	4,400	B.
July	95	29	49.4	3,040	B.
August	29	2.2	8.97	552	C.
September	4.2	1.0	2.35	140	C.
October	7.0	.0	3.54	218	C.
November	7.0	.0	.99	58.9	D.
The period				8,900	

POST CREEK NEAR ST. IGNATIUS, MONT.

Post Creek rises on the western slope of the Mission Range and flows southwestward to Mission Creek. It is the outlet of Lake McDonald, and its flow can be equalized throughout the year by utilizing the lake for storage.

The gaging station, which was established September 21, 1906, to obtain data for use in connection with irrigation and power projects, is located at the home of Joseph Allard, about 10 miles north of St. Ignatius, Mont.

Two small ditches divert water above the gage to irrigate a few acres. The North Fork, the only important tributary, enters 2 or 3 miles below the gage.

During the flood of June, 1908, a new channel was opened through the timber on the right bank. Flow in this channel was first measured November 9, 1908. Computations after June, 1908, have been revised to include the flow in this new channel and supersede data as published in Water-Supply Paper 252.

The staff-gage datum has remained unchanged. Discharge measurements are made by wading just below the gage.

The current is swift, and the records of flow are but little affected by ice during the winter months. The channel is permanent, and the conditions for obtaining accurate discharge data are good.

Discharge measurements of Post Creek near St. Ignatius, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 20	Raymond Richards	23	15.7	0.91	24.7
May 27	J. E. Stewart	34	75.5	1.97	208
July 25	Raymond Richards	52	67.8	1.76	149
Sept. 10[a]	W. C. Sibthrop			1.33	77.1
Oct. 14	Raymond Richards	29	28.8	1.26	54.1

[a] Measurement doubtful.

Daily gage height, in feet, of Post Creek near St. Ignatius, Mont., for 1909.

[Joseph Allard, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	0.9	0.9	0.95	1.0	1.7	2.4	.....	1.4	.....	.....	1.2
2	1.0	.9	.9	.95	1.0	2.2	2.4	.....	1.4	.....	.....	1.2
3	1.0	.9	.9	.95	1.25	2.4	2.4	.....	1.4	.....	.....	1.15
4	1.0	.9	.9	.95	1.1	2.4	2.35	.....	1.4	.....	.....	1.1
5	.....	.9	.9	.95	1.1	2.5	2.3	.....	1.3	.....	.....	1.1
6	.....	.9	.9	.95	1.1	2.3	2.4	.....	1.3	.....	.....	1.0
7	1.0	.9	.9	.95	1.1	2.15	2.4	.....	1.3	.....	.....	1.0
8	.95	.9	.9	.95	1.1	2.0	2.4	.....	1.3	.....	.....	1.0
9	.9	.9	.9	.95	1.1	1.9	2.2	.....	1.3	.....	.....	1.0
10	.9	.9	.95	.95	1.1	1.8	2.2	.....	1.3	.....	.....	1.1
11	.9	.9	1.0	.95	1.1	1.8	2.1	.....	1.3	.....	.....	1.1
12	.9	.9	1.25	.95	.....	1.8	2.1	.....	.....	.....	.....	1.1
13	.9	.9	1.25	.95	.....	1.9	2.0	.....	.....	.....	.....	1.1
14	.9	.9	1.0	.95	.....	2.2	2.0	.....	.....	.....	.....	1.15
15	.9	.9	1.0	.95	1.1	2.5	2.0	.....	.....	.....	.....	1.2
16	.9	.9	.95	.9	1.1	2.5	2.0	.....	.....	.....	.....	1.2
17	.9	.9	.95	.9	1.1	.....	1.9	.....	.....	.....	.....	1.2
18	.95	.9	.95	.9	1.1	2.45	1.9	.....	.....	.....	.....	1.2
19	.95	.9	.95	.9	1.1	2.45	1.9	.....	.....	.....	.....	1.2
20	.95	.9	.95	.9	1.1	2.65	1.8	.....	.....	.....	.....	1.15
21	.95	.9	.95	.9	1.2	2.85	1.8	.....	.....	.....	.....	1.15
22	.9	.9	.95	.95	1.2	4.5	1.75	.....	.....	.....	.....	1.15
23	.9	.9	.95	.95	1.2	2.25	1.7	.....	.....	.....	.....	1.15
24	.9	.9	.95	1.0	1.25	2.25	1.7	.....	.....	.....	.....	1.1
25	.9	.9	.95	1.0	1.4	2.2	1.7	.....	.....	.....	.....	1.05
26	.9	.9	.95	1.0	1.65	2.2	1.6	1.4	.....	.....	.....	1.15
27	.9	.9	.95	1.0	1.9	2.1	1.6	1.4	.....	.....	.....	1.15
28	.9	.9	.95	1.0	2.0	2.1	1.6	1.4	.....	.....	.....	1.15
29	.9	.....	.95	1.0	1.85	2.1	1.5	1.4	.....	.....	.....	1.15
30	.9	.....	.95	1.0	1.7	2.3	1.4	1.4	.....	.....	.....	1.15
31	.9	.....	.95	.....	1.6	.....	1.4	1.4	.....	.....	.....	1.15

NOTE.—Ice conditions from about Jan. 5 to 11; and Dec. 19 to 31. The gap in the year's records is due to absence of observer.

Daily discharge, in second-feet, of Post Creek near St. Ignatius, Mont., for 1908–9.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	25	22	27	29	72	196	241	136	51	51	36	36
2	25	22	27	29	85	275	316	136	41	46	36	36
3	25	22	27	32	85	262	331	115	41	43	36	36
4	25	22	27	32	72	280	300	115	41	41	36	36
5	25	22	27	32	85	744	300	99	41	41	36	36
6	25	22	27	32	100	1,000	276	95	41	39	36	36
7	25	22	27	32	114	1,300	285	86	49	36	36	36
8	25	22	27	32	146	1,800	285	78	66	32	36	36
9	25	25	27	32	178	2,300	306	78	63	32	36	36
10	25	25	27	32	146	2,800	346	78	63	32	36	36
11	25	25	28	32	117	2,500	316	78	57	32	36	36
12	25	25	28	35	114	2,200	294	70	51	32	36	36
13	25	25	28	36	108	2,000	300	78	57	32	36	32
14	25	25	28	38	117	1,800	300	78	57	32	36	32
15	25	25	33	42	126	1,600	331	75	57	32	36	28
16	25	25	33	46	146	1,400	331	70	66	32	36	26
17	20	25	33	55	126	1,250	300	70	95	32	36	24
18	20	27	33	60	132	1,100	270	78	111	32	36	24
19	20	27	33	63	121	1,000	227	78	136	32	36	28
20	20	27	33	66	100	900	220	78	115	32	36	28
21	20	27	35	75	100	800	213	70	95	32	36	32
22	20	27	35	78	108	700	206	70	95	32	36	32
23	20	27	35	78	100	600	199	70	78	32	36	32
24	20	27	35	88	108	500	192	70	78	32	36	32
25	20	27	35	103	126	400	185	70	70	32	36	32

Daily discharge, in second-feet, of Post Creek near St. Ignatius, Mont., for 1908–9—Con.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
26	20	27	33	97	167	343	178	66	66	32	36	32
27	20	27	33	85	160	278	171	63	63	36	36	32
28	20	30	33	75	178	213	164	57	63	36	36	32
29	20	27	33	72	160	208	157	57	57	39	36	32
30	20	.....	33	72	167	191	150	51	51	41	36	32
31	20	.....	33	.....	156	.....	144	51	.....	36	.....	32
1909.												
1	32	24	24	28	32	136	331	78	78	63	50	51
2	32	24	24	28	32	270	331	78	78	59	50	51
3	32	24	24	28	57	331	331	78	78	55	55	46
4	32	24	24	28	41	331	315	78	78	54	60	41
5	32	24	24	28	41	362	300	78	63	53	65	41
6	32	24	24	28	41	300	331	78	63	52	70	32
7	32	24	24	28	41	256	331	78	63	52	65	32
8	28	24	24	28	41	213	331	78	63	52	63	32
9	24	24	24	28	41	186	270	78	63	52	62	32
10	24	24	28	28	41	160	270	78	63	52	61	41
11	24	24	32	28	41	160	241	78	63	52	60	41
12	24	24	57	28	41	160	241	78	63	52	60	41
13	24	24	57	28	41	186	213	78	63	53	58	41
14	24	24	32	28	41	270	213	78	62	53	57	46
15	24	24	32	28	41	362	213	78	62	54	56	51
16	24	24	28	24	41	362	213	78	62	54	55	51
17	24	24	28	24	41	354	186	78	62	54	55	51
18	28	24	28	24	41	346	186	78	62	53	55	51
19	28	24	28	24	41	346	186	78	58	52	55	51
20	28	24	28	24	41	410	160	78	56	52	53	46
21	28	24	28	24	51	474	160	78	56	51	51	46
22	24	24	28	28	51	1,020	148	78	56	51	50	46
23	24	24	28	28	51	285	136	78	56	51	50	46
24	24	24	28	32	57	285	136	78	56	51	50	41
25	24	24	28	32	78	270	136	78	55	51	50	36
26	24	24	28	32	126	270	115	78	55	50	50	46
27	24	24	28	32	186	241	115	78	55	50	50	46
28	24	24	28	32	213	241	115	78	55	50	52	46
29	24	.....	28	32	173	241	95	78	55	50	52	46
30	24	.....	28	32	136	300	78	78	65	50	52	46
31	24	.....	28	.....	115	.....	78	78	.....	50	.....	46

NOTE.—These discharges, except as noted below, are based on rating curves applicable as follows: Jan. 1 to Mar. 31, 1908, indirect method for shifting channels used. Apr. 1 to June 5, 1908, well defined between 25 and 380 second-feet. June 26, 1908, to Dec. 31, 1909, includes the flow in new channel and is fairly well defined between 24 and 215 second-feet. Discharges June 6 to 25, 1908, estimated; July 20 to 31, 1908, estimated by hydrograph comparison with the flow at neighboring stations; Jan. 5, 6, May 11 to 14, and June 17, 1909, interpolated; Aug. 1 to 25, and Sept. 12 to Nov. 30, 1909, estimated by hydrograph comparison with neighboring stations.

Monthly discharge of Post Creek near St. Ignatius, Mont., for 1908–9.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
January	25	20	22.6	1,390	B.
February	30	22	25.1	1,440	C.
March	35	27	30.7	1,890	C.
April	103	29	53.7	3,200	B.
May	178	72	123	7,560	A.
June	2,800	191	1,030	61,300	D.
July	346	144	253	15,600	D.
August	136	51	79.5	4,890	C.
September	136	41	67.2	4,000	B.
October	51	32	35.3	2,170	C.
November	36	36	36.0	2,140	C.
December	36	24	32.5	2,000	C.
The year	2,800	20	149	108,000	

Monthly discharge of Post Creek near St. Ignatius, Mont., for 1908-9—Continued.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1909.					
January	32	24	26.5	1,630	D.
February	24	24	24	1,330	C.
March	57	24	29.1	1,790	C.
April	32	24	28.1	1,670	B.
May	213	32	66.3	4,080	B.
June	1,020	136	304	18,100	B.
July	331	78	210	12,900	B.
August	78	78	78	4,800	C.
September	78	55	62.2	3,700	C.
October	63	50	52.5	3,230	C.
November	70	50	55.7	3,310	D.
December	51	32	43.9	2,700	D.
The year	1,020	24	81.7	59,200	

NOTE.—Estimates for 1908 have been revised on basis of additional data and supersede those published for this station in Water-Supply Paper 252, page 110.

JOCKO RIVER DRAINAGE BASIN.

DESCRIPTION.

Jocko River rises in the eastern part of the Flathead Indian Reservation and flows in a general northwesterly direction into Flathead River near Dixon.

JOCKO RIVER NEAR JOCKO, MONT.

This station, which was established August 20, 1908, is located at the highway bridge on the road between Jocko and Ravalli about 1¼ miles northwest of the Jocko Agency. Big Knife Creek enters Jocko River above the gage, and Finley, Agency, and Valley creeks enter below the station. A few small ditches divert water from Jocko River between its source and Ravalli, and the waters of its tributaries are used to some extent for irrigation near the Jocko Agency. Indian ditch, diverted from the East Finley, is the largest ditch now in operation. Five thousand acres are to be irrigated in the upper Jocko Valley.

A staff gage is nailed to the middle pier of the downstream side of the highway bridge. The gage datum has remained constant.

Measurements are made by wading at low water and from the highway bridge in flood season. The channel is not likely to shift in ordinary stages.

The stream is being used by the Reclamation Service for irrigation. This river also affords opportunities for power development, as it carries a good supply of water at a rapid fall, and in many places is bounded by high cliffs.

Discharge measurements of Jocko River near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	Raymond Richards	36	54.6	6.95	72.5
May 22	J. E. Stewart	72	113	8.40	433
June 17	Raymond Richards	43	152	9.00	1,000
July 31	J. E. Stewart	40	70.2	7.82	232
Oct. 19	Raymond Richards	47	50.5	7.20	107

Daily gage height, in feet, of Jocko River near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			8.95	8.42	7.85	7.42	7.32	7.15	7.21
2			9.23	8.42	7.81	7.46	7.30	7.16	7.10
3		7.32	9.30	8.40	7.79	7.45	7.28	7.61	7.02
4		7.75	9.25	8.38	7.78	7.49	7.28	7.57	
5		7.95	9.32	8.34	7.76	7.43	7.26	7.46	
6		7.82	9.15	8.58	7.73	7.41	7.26	7.45	
7		7.70	8.99	8.48	7.71	7.38	7.33	7.37	
8		7.63	8.90	8.37	7.70	7.36	7.31	7.33	
9		7.62	8.87	8.30	7.69	7.35	7.29	7.31	
10		7.72	8.87	8.28	7.67	7.34	7.31	7.31	
11		7.70	8.79	8.45	7.66	7.35	7.32	7.28	
12		7.70	8.80	8.35	7.63	7.38	7.30	7.26	
13	6.90	7.65	8.86	8.27	7.61	7.36	7.27	7.24	
14		7.66	9.00	8.21	7.60	7.35	7.25	7.07	
15		7.75	9.11	8.19	7.57	7.33	7.24	7.03	
16		7.80	9.20	8.14	7.57	7.33	7.22	7.07	
17	6.95	7.78	9.16	8.10	7.56	7.32	7.21	7.15	
18			9.18	8.07	7.55	7.33	7.20	7.18	
19	6.98	7.90	9.14	8.03	7.54	7.34	7.21	7.24	
20			9.05	8.02	7.54	7.31	7.20	7.23	
21	7.00	8.35	8.99	8.02	7.55	7.36	7.20	7.20	
22		8.41	8.86	7.98	7.53	7.35	7.19	7.19	
23	7.00	8.43	8.78	7.95	7.52	7.33	7.18	7.29	
24		8.46	8.75	7.92	7.63	7.33	7.17	7.35	
25		8.65	8.70	7.89	7.62	7.36	7.16	7.31	
26	7.20	8.73	8.65	7.88	7.57	7.35	7.16	7.27	
27		8.95	8.59	8.00	7.55	7.33	7.16	7.23	
28		8.97	8.56	8.08	7.49	7.30	7.18	7.22	
29		8.94	8.52	7.96	7.47	7.32	7.16	7.22	
30	7.19	8.70	8.50	7.92	7.44	7.33	7.16	7.23	
31		8.65		7.87	7.43		7.16		

Daily discharge, in second-feet, of Jocko River near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		116	929	451	249	151	132	103	113
2		124	1,340	451	239	159	128	105	95
3		132	1,450	440	234	157	125	191	83
4		224	1,380	431	231	165	125	182	
5		276	1,480	412	226	153	121	159	
6		241	1,180	551	219	149	121	157	
7		212	986	486	214	143	134	141	
8		196	858	426	212	139	130	134	
9		194	823	394	210	138	126	130	
10		217	823	386	205	136	130	130	
11		212	732	468	203	138	132	125	
12		212	742	417	196	143	128	121	
13	65	200	812	382	191	139	123	118	
14	66	203	1,000	359	189	138	120	90	
15	68	224	1,160	352	182	134	118	84	

Daily discharge, in second-feet, of Jocko River near Jocko, Mont., for 1909.—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	70	236	1,300	335	182	134	114	90	.....
17	72	231	1,240	321	180	132	113	103	.....
18	74	246	1,270	312	178	134	111	108	.....
19	77	262	1,210	299	176	136	113	118	.....
20	78	340	1,080	296	176	130	111	116	.....
21	80	417	986	296	178	139	111	111	.....
22	80	446	812	284	174	138	109	109	.....
23	80	457	723	276	171	134	108	126	.....
24	90	474	694	268	196	134	106	138	.....
25	110	606	646	259	194	139	105	130	.....
26	111	675	606	257	182	138	105	123	.....
27	111	929	558	290	178	134	105	116	.....
28	110	957	538	315	165	128	108	114	.....
29	109	915	511	279	161	132	105	114	.....
30	109	646	497	268	155	134	105	116	.....
31	.....	606	.....	254	153	.....	105	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 75 and 260 second-feet, and fairly well defined up to 1,000 second-feet. Discharges interpolated for missing days between Apr. 13 and May 21.

Monthly discharge of Jocko River near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum	Mean.		
Apr. 13-30	111	65	86.7	3,100	B.
May	957	116	369	22,700	A.
June	1,480	497	946	56,300	A.
July	551	254	355	21,800	A.
August	249	153	194	11,900	A.
September	165	128	140	8,330	A.
October	134	105	117	7,190	A.
November	191	84	123	7,320	A.
The period	.....	.....	.....	139,000	

JOCKO RIVER AT RAVALLI, MONT.

This station, which is located about 400 feet downstream from a point opposite the railroad station at Ravalli, Mont., was established October 18, 1906, to obtain data for use in connection with irrigation and power development.

Several small irrigation ditches divert water above the staff gage, but the total diversion probably does not exceed 1 per cent of the discharge of the stream.

The current is swift and the flow is but little affected by ice during the winter months. The channel shifts during very high water, but is permanent at ordinary stages. The conditions for obtaining accurate discharge data are good. The gage datum has remained unchanged.

At ordinary and low stages measurements are made by wading near the gage. During flood stages they can be made from a highway bridge three-fourths of a mile above the gage.

Discharge measurements of Jocko River at Ravalli, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 18	Raymond Richards	54	62.8	2.35	169
May 28	J. E. Stewart	52	189	4.85	1,130
June 17	Raymond Richards	54	205	4.72	1,320
Aug. 4	do	53	102	2.51	290
Oct. 18	do	50	74.6	1.97	183

Daily gage height, in feet, of Jocko River at Ravalli, Mont., for 1909.

[G. D. Pendray, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.4	2.4	4.5	3.2	2.6	2.1	2.0	1.9	1.9
2	2.4	2.4	2.5	5.0	3.0	2.5	2.1	2.0	1.9	1.9
3	2.4	2.4	2.7	5.5	3.1	2.5	2.1	2.0	2.0	1.9
4	2.4	2.4	2.9	5.3	3.1	2.5	2.1	2.0	2.1	1.9
5	2.4	2.4	3.0	5.3	3.2	2.5	2.1	2.0	2.2	1.9
6	2.4	2.5	3.1	5.0	3.4	2.5	2.1	2.0	2.1	1.9
7	2.4	2.5	3.2	4.7	3.2	2.5	2.0	2.0	2.0	1.9
8	2.4	2.5	3.0	4.0	3.1	2.4	2.0	2.0	2.0	1.9
9	2.4	2.5	3.1	4.0	3.0	2.4	2.0	2.0	2.0	1.9
10	2.4	2.5	3.0	4.0	3.0	2.4	2.0	1.9	2.0	1.9
11	2.4	2.4	2.9	4.0	3.0	2.3	2.0	1.9	2.0	1.9
12	2.4	2.4	3.0	3.9	3.0	2.3	2.0	1.9	2.0	1.9
13	2.4	2.4	3.1	3.9	3.0	2.3	2.0	1.9	1.9	1.9
14	2.4	2.5	3.2	3.9	3.0	2.3	2.0	1.9	1.9	1.9
15	2.4	2.5	3.2	4.1	2.9	2.3	2.0	1.9	1.9	1.9
16	2.5	2.5	3.2	4.4	2.8	2.3	2.0	1.9	1.9	1.9
17	2.4	2.4	3.2	4.7	2.8	2.3	2.0	1.9	1.9	.....
18	2.4	2.4	3.2	4.7	2.8	2.3	2.0	1.9	1.9	.....
19	2.4	2.4	3.3	4.3	2.8	2.3	2.0	1.9	1.9	.....
20	2.4	2.4	3.3	4.0	2.8	2.3	2.0	1.9	1.9	.....
21	2.4	2.4	3.3	3.8	2.8	2.3	2.0	1.9	1.9	.....
22	2.4	2.4	3.3	3.6	2.5	2.3	2.0	1.9	1.9	.....
23	2.4	2.4	3.3	3.4	2.5	2.3	2.0	1.9	1.9	.....
24	2.4	2.4	3.4	3.4	2.4	2.3	2.0	1.9	1.9	.....
25	2.4	2.4	3.4	3.3	2.5	2.3	2.0	1.9	1.9	.....
26	2.3	2.4	3.9	3.0	2.6	2.3	2.0	1.9	1.8	.....
27	2.3	2.4	5.0	2.9	2.7	2.3	2.0	1.9	1.8	.....
28	2.4	2.4	4.8	2.8	2.9	2.3	2.0	1.9	1.9	.....
29	2.4	2.4	4.6	2.7	2.6	2.3	2.0	1.9	1.9	.....
30	2.4	2.4	4.6	2.7	2.5	2.3	2.0	1.9	1.9	.....
31	2.4	.....	4.3	.....	2.5	2.2	.....	1.9	.....	.....

NOTE. Probable ice conditions January, February, and the latter part of December.

Daily discharge, in second-feet, of Jocko River at Ravalli, Mont., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	182	182	182	1,010	530	315	207	192	179	179
2	182	182	205	1,260	450	288	207	192	179	179
3	182	182	248	1,540	490	288	207	192	192	179
4	182	182	302	1,430	490	288	207	192	207	179
5	182	182	332	1,480	530	288	207	192	224	179
6	182	202	264	1,320	620	288	207	192	207	179
7	182	202	398	1,160	530	288	192	192	192	179
8	182	202	332	840	490	264	192	192	192	179
9	182	202	364	840	450	264	192	192	192	179
10	182	202	332	840	450	264	192	179	192	179
11	182	182	302	840	450	243	192	179	192	179
12	182	182	332	850	450	243	192	179	192	179
13	182	182	364	850	450	243	192	179	179	179
14	182	202	398	850	450	243	192	179	179	179
15	182	202	398	940	410	243	192	179	179	179

Daily discharge in second-feet, of Jocko River at Ravalli, Mont., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	202	202	398	1,130	375	243	192	179	179	179
17	182	182	398	1,490	375	243	192	179	179	.....
18	182	182	398	1,490	375	243	192	179	179	.....
19	182	182	432	1,080	375	243	192	179	179	.....
20	182	182	432	915	375	243	192	179	179	.....
21	182	182	432	810	375	243	192	179	179	.....
22	182	182	432	710	288	243	192	179	179	.....
23	182	182	432	620	288	243	192	179	179	.....
24	182	182	468	620	264	243	192	179	179	.....
25	182	182	468	575	288	243	192	179	179	.....
26	164	182	700	450	315	243	192	179	168	.....
27	164	182	1,240	410	345	243	192	179	168	.....
28	182	182	1,130	375	410	243	192	179	179	.....
29	182	182	1,030	345	315	243	192	179	179	.....
30	182	182	1,030	345	288	243	192	179	179	.....
31	182	.....	880	.....	288	224	.....	179	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 1 to May 25, fairly well defined between 160 and 330 second-feet. May 26 to June 18, indirect method for shifting channels used. June 19 to Dec. 16, fairly well defined between 170 and 315 second-feet.

Monthly discharge of Jocko River at Ravalli, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
March	202	164	181	11,100	C.
April	202	182	187	11,100	B.
May	1,240	182	486	29,900	B.
June	1,540	345	914	54,400	B.
July	620	264	406	25,000	B.
August	315	224	255	15,700	B.
September	207	192	195	11,600	B.
October	192	179	183	11,300	B.
November	224	168	185	11,000	B.
December 1-16	179	179	179	5,680	C.
The period	.....	.....	.....	187,000	

BIG KNIFE CREEK NEAR JOCKO, MONT.

Big Knife Creek is a small stream that rises in the mountains and flows in a westerly direction until it joins Jocko River about a mile north of the Jocko Agency.

The station, which was established August 19, 1908, is located near the small highway bridge which spans the creek about 2½ miles northeast of Jocko, Mont. The staff gage is located just above the bridge. All measurements are made by wading.

There are no ditches diverted from this stream. The creek freezes over in cold weather. The staff gage datum has remained unchanged. The channel does not shift except in extremely high water.

Discharge measurements of Big Knife Creek near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 16	Raymond Richards	13	7.7	0.57	6.8
May 22	J. E. Stewart	11	9.1	.71	12.7
June 16	Raymond Richards	14	18.3	1.11	45.7
July 31	J. E. Stewart	9	11.4	.89	21.1
Oct. 19	Raymond Richards	13	11.7	.69	11.7

Daily gage height, in feet, of Big Knife Creek near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	0.96	1.00	0.89	0.78	0.74	0.67
2	.....	.....	1.05	.99	.88	.79	.73	.68
3	.....	.....	1.07	.98	.87	.82	.73	.68
4	.....	.....	1.06	.97	.86	.79	.73	.69
5	.....	0.63	1.09	.96	.86	.78	.73	.68
6	.....	.63	1.06	1.09	.86	.77	.72	.69
7	.....	.....	1.02	1.05	.86	.77	.73	.68
8	.....	.63	.99	1.01	.85	.77	.72	.68
9	.....	.65	.99	.99	.85	.76	.71	.68
10	.....	.63	.96	.98	.85	.76	.71	.68
11	.....	.65	.95	.99	.84	.78	.70	.67
12	.....	.65	.96	.99	.84	.78	.70	.67
13	0.57	.63	.97	.98	.83	.77	.70	.67
14	.....	.65	1.01	.96	.83	.76	.70	.66
15	.....	.65	1.08	.94	.82	.75	.70	.66
16	.57	.66	1.13	.94	.82	.75	.70	.66
17	.....	.66	1.13	.93	.81	.75	.70	.66
18	.....	.66	1.13	93	.81	.75	.70	.66
19	.57	.....	1.15	.92	.80	.75	.67	.66
20	.....	.....	1.13	.92	.80	.75	.69	.66
21	.....	.....	1.12	.91	.81	.76	.69	.65
22	.....	.71	1.08	.90	.80	.75	.69	.66
23	.....	.72	1.07	.90	.80	.75	.69	.66
24	.58	.72	1.04	.90	.80	.74	.69	.66
25	.....	.76	1.04	.90	.80	.74	.69	.65
26	.....	.79	1.02	.90	.79	.74	.69	.65
27	.....	.87	1.00	.98	.80	.73	.68	.65
28	.60	.89	1.00	.93	.79	.73	.68	.65
29	.....	.88	.99	.91	.79	.74	.68	.65
30	.59	.87	1.00	.90	.78	.74	.68	.65
31	.....	.87	.....	.89	.78	.....	.68	.....

Daily discharge, in second-feet, of Big Knife Creek near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	7.7	28	32	22	15.4	13.5	10.5
2	.....	8.0	38	31	22	15.8	13.	10.8
3	.....	8.3	40	30	21	17.6	13.	10.8
4	.....	8.6	39	29	20	15.8	13.	11.2
5	.....	8.9	43	28	20	15.4	13.	10.8
6	.....	8.9	39	43	20	14.9	12.5	11.2
7	.....	8.9	34	38	20	14.9	13.	10.8
8	.....	8.9	31	33	20	14.9	12.5	10.8
9	.....	9.7	31	31	20	14.4	12.1	10.8
10	.....	8.9	28	30	20	14.4	12.1	10.8
11	.....	9.7	28	31	19.	15.4	11.6	10.5
12	.....	9.7	28	31	19.	15.4	11.6	10.5
13	6.8	8.9	29	30	18.3	14.9	11.6	10.5
14	6.8	9.7	33	28	18.3	14.4	11.6	10.1
15	6.8	9.7	42	27	17.6	14.	11.6	10.1

Daily discharge, in second-feet, of Big Knife Creek near Jocko, Mont., for 1909—Cont'd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
16	6.8	10.1	49	27	17.6	14.	11.6	10.1
17	6.8	10.1	49	26	17.	14.	11.6	10.1
18	6.8	10.1	49	26	17.	14.	11.6	10.1
19	6.8	10.6	52	25	16.3	14.	10.5	10.1
20	6.8	11.1	49	25	16.3	14.	11.2	10.1
21	6.9	11.6	47	24	17.	14.4	11.2	9.7
22	6.9	12.1	42	23	16.3	14.	11.2	10.1
23	7.0	12.5	40	23	16.3	14.	11.2	10.1
24	7.1	12.5	37	23	16.3	13.5	11.2	10.1
25	7.2	14.4	37	23	16.3	13.5	11.2	9.7
26	7.4	15.8	34	23	15.8	13.5	11.2	9.7
27	7.6	21	32	30	16.3	13.	10.8	9.7
28	7.8	22	32	26	15.8	13.	10.8	9.7
29	7.6	22	31	24	15.8	13.5	10.8	9.7
30	7.5	21	32	23	15.4	13.5	10.8	9.7
31	.....	21	.....	22	15.4	.....	10.8	.....

NOTE.—These discharges are based on a rating curve that is well defined between 6 and 14 second-feet and fairly well defined up to 45 second-feet. Discharges interpolated for missing gage heights Apr. 14 to May 21.

Monthly discharge of Big Knife Creek near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 13–30	7.8	6.8	7.08	253	C.
May	22	7.7	12.0	738	C.
June	52	28	37.4	2,230	B.
July	43	22	27.9	1,720	B.
August	22	15.4	18.0	1,110	B.
September	17.6	13.0	14.4	857	B.
October	13.5	10.5	11.7	719	B.
November	11.2	9.7	10.3	613	B.
The period	.....	.....	.....	8,240	

AGENCY CREEK NEAR JOCKO, MONT.

Agency Creek is a small stream that rises in the Mission Range and flows in a westerly direction until it joins Jocko River near Agency.

The stream has a steep grade and a rapid flow. It partially freezes over during the colder months. Its flow is controlled by the melting snow in the mountains.

The station, which was established August 19, 1908, is located about 2 miles east of Jocko, just above the intake of the Matt ditch, the largest ditch leaving the stream. Smaller ditches are diverted below. A small staff gage is used. All measurements are made by wading.

Discharge measurements of Agency Creek near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 16	Raymond Richards	17	6.1	0.51	4.3
May 21	J. E. Stewart	14	13.4	1.25	21.0
June 16	Raymond Richards	21	25.6	2.36	86.8
July 31	J. E. Stewart	18	15.8	1.40	26.3
Oct. 19	Raymond Richards	17	8.3	.70	6.0

Daily gage height, in feet, of Agency Creek, near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.05	.....	1.34	0.82	0.80	0.67	0.69
2	.....	.....	2.55	1.83	1.24	.86	.78	.69	.68
3	.....	.....	2.57	1.75	1.20	.88	.78	.70	.63
4	.....	1.05	2.42	1.74	1.16	.91	.78	.73	.....
5	.....	1.07	2.44	1.65	1.13	.81	.77	.73	.....
6	.....	.95	2.21	2.15	1.10	.86	.77	.74	.....
7	.....	.90	2.05	2.02	1.08	.84	.78	.72	.....
8	.....	.83	1.96	1.86	1.04	.83	.77	.70	.....
9	.....	.83	1.98	1.74	1.02	.82	.76	.71	.....
10	.....	.90	1.95	1.65	1.00	.82	.75	.72	.....
11	.....	.88	1.92	1.68	1.00	.86	.75	.70	.....
12	.....	.85	1.94	1.65	.98	.87	.75	.69	.....
13	.....	.83	2.00	1.59	.97	.86	.74	.67	.....
14	.....	.83	2.15	1.55	.96	.83	.73	.64	.....
15	.....	.86	2.35	1.54	.93	.82	.72	.64	.....
16	0.51	.92	2.43	1.50	.93	.82	.72	.68	.....
17	.....	.92	2.33	1.45	.92	.82	.72	.68	.....
18	.....	.90	2.39	1.40	.90	.82	.72	.69	.....
19	.....	.....	2.25	1.30	.90	.80	.70	.70	.....
20	.....	.....	2.29	1.30	.89	.81	.72	.68	.....
21	.....	1.25	2.19	1.27	.90	.81	.71	.67	.....
22	.....	1.25	2.10	1.20	.90	.80	.70	.68	.....
23	.....	1.24	2.02	1.18	.88	.80	.69	.71	.....
24	.....	1.24	1.95	1.16	.88	.80	.69	.72	.....
25	.....	1.63	1.95	1.13	.86	.80	.69	.71	.....
26	.65	1.75	1.93	1.11	.85	.79	.69	.71	.....
27	.....	2.05	1.86	1.48	.88	.78	.69	.69	.....
28	.....	2.11	1.84	1.65	.85	.78	.68	.69	.....
29	.....	2.02	1.87	1.55	.85	.80	.67	.69	.....
30	.....	1.82	1.99	1.50	.84	.81	.67	.69	.....
31	.....	1.75	.....	1.39	.83	.....	.67	.....	.....

Daily discharge, in second-feet, of Agency Creek near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	11.6	64	54	24	8.4	8.0	5.6	5.8
2	.....	12.6	102	49	19.7	9.3	7.6	5.8	5.7
3	.....	13.6	104	44	18.1	9.7	7.6	6.0	5.0
4	.....	15.6	92	43	16.9	10.3	7.6	6.6	.....
5	.....	16.2	93	38	15.9	8.2	7.4	6.6	.....
6	.....	13.0	75	70	15.0	9.3	7.4	6.8	.....
7	.....	11.8	64	61	14.5	8.8	7.6	6.4	.....
8	.....	10.3	57	51	13.4	8.6	7.4	6.0	.....
9	.....	10.3	59	43	12.9	8.4	7.2	6.2	.....
10	.....	11.8	56	38	12.4	8.4	7.0	6.4	.....
11	.....	11.4	54	40	12.4	9.3	7.0	6.0	.....
12	.....	10.7	56	38	11.9	9.5	7.0	5.8	.....
13	.....	10.3	60	34	11.7	9.3	6.8	5.6	.....
14	.....	10.3	70	32	11.5	8.6	6.6	5.1	.....
15	.....	10.9	86	32	10.8	8.4	6.4	5.1	.....
16	4.4	12.3	92	30	10.8	8.4	6.4	5.7	.....
17	4.6	12.3	84	28	10.6	8.4	6.4	5.7	.....
18	4.8	11.8	89	26	10.1	8.4	6.4	5.8	.....
19	5.0	15.2	78	22	10.1	8.0	6.0	6.0	.....
20	5.2	18.6	81	22	9.9	8.2	6.4	5.7	.....
21	5.5	22	73	21	10.1	8.2	6.2	5.6	.....
22	5.7	22	67	18.1	10.1	8.0	6.0	5.7	.....
23	5.9	21	61	17.5	9.7	8.0	5.8	6.2	.....
24	6.1	21	56	16.9	9.7	8.0	5.8	6.4	.....
25	6.3	38	56	15.9	9.3	8.0	5.8	6.2	.....
26	6.6	45	55	15.3	9.0	7.8	5.8	6.2	.....
27	7.6	64	51	29	9.7	7.6	5.8	5.8	.....
28	8.6	69	49	38	9.0	7.6	5.7	5.8	.....
29	9.6	62	51	32	9.0	8.0	5.6	5.8	.....
30	10.6	49	59	30	8.8	8.2	5.6	5.8	.....
31	.....	45	.....	26	8.6	.....	5.6	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 16 to June 3, well defined between 5 and 23 second-feet; June 4 to Dec. 3, well defined between 6 and 26 second-feet. Discharges interpolated Apr. 17 to 25, Apr. 27 to May 3, and May 19 and 20.

Monthly discharge of Agency Creek near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 16-30	10.6	4.4	6.43	191	B.
May	69	10.3	22.9	1,410	B.
June	104	49	69.8	4,150	B.
July	70	15.3	34.0	2,090	B.
August	24	8.6	12.1	744	B.
September	10.3	7.6	8.51	506	B.
October	8.0	5.6	6.58	405	B.
November	6.8	5.1	5.95	354	B.
The period				9,850	

BLODGETT CREEK NEAR JOCKO, MONT.

Blodgett Creek is a very small stream that rises in the Mission Range and flows into Agency Creek.

The station was established May 22, 1909, about 1½ miles northeast of Jocko, Mont., to procure data for use in connection with irrigation projects. A staff gage is located on the left bank. Discharge measurements are made by wading.

Discharge measurements of Blodgett Creek near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 22	J. E. Stewart	2.5	0.7	0.80	1.0
June 11	Raymond Richards	5.9	1.5	.95	3.5
July 31	J. E. Stewart	2.7	1.0	.70	1.4
Oct. 19	Raymond Richards	2.5	.6	.55	.6

Daily gage height, in feet, of Blodgett Creek near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		0.90	0.77	0.69	0.59	0.55	0.52	0.50
2		.97	.76	.68	.60	.55	.52	.50
3		1.00	.76	.68	.64	.54	.51	.50
4		.95	.75	.67	.60	.54	.52	.50
5		.95	.75	.67	.60	.54	.52	
6		.92	.80	.67	.59	.54	.52	
7		.91	.78	.67	.59	.54	.52	
8		.91	.76	.66	.58	.54	.51	
9		.94	.76	.66	.58	.54	.51	
10		.93	.76	.66	.58	.53	.52	
11		.92	.75	.65	.60	.53	.52	
12		.90	.76	.65	.59	.54	.52	
13		.90	.75	.65	.58	.54	.51	
14		.88	.74	.65	.57	.53	.51	
15		.89	.73	.64	.56	.53	.51	
16		.89	.73	.64	.56	.53	.51	
17		.87	.73	.64	.56	.53	.51	
18		.83	.73	.63	.56	.53	.51	
19		.82	.72	.63	.56	.57	.52	
20		.82	.73	.63	.56	.55	.51	

Daily gage height, in feet, of Blodgett Creek near Jocko, Mont., in 1909—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	.81	.72	.63	.57	.55	.51	.....
22	0.81	.81	.71	.62	.56	.53	.51	.....
23	.80	.80	.72	.61	.56	.53	.51	.....
24	.80	.80	.71	.60	.55	.53	.52	.....
25	.84	.79	.71	.60	.55	.52	.51	.....
26	.85	.79	.71	.60	.55	.52	.51	.....
27	.90	.78	.79	.61	.55	.52	.50	.....
28	.91	.78	.73	.60	.55	.52	.50	.....
29	.90	.78	.72	.60	.55	.52	.50	.....
30	.90	.77	.71	.60	.56	.52	.50	.....
31	.88	.....	.69	.59	.....	.52	.....	.....

Daily discharge, in second-feet, of Blodgett Creek near Jocko, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.5	2.0	1.3	0.8	0.6	0.5	0.4
2	.....	2.9	1.9	1.3	.8	.6	.5	.4
3	.....	3.4	1.9	1.3	1.0	.6	.4	.4
4	.....	2.9	1.8	1.2	.8	.6	.5	.4
5	.....	2.9	1.8	1.2	.8	.6	.5	.....
6	.....	2.5	2.2	1.2	.8	.6	.5	.....
7	.....	2.5	2.0	1.2	.8	.6	.5	.....
8	.....	2.5	1.9	1.2	.7	.6	.4	.....
9	.....	3.3	1.9	1.2	.7	.6	.4	.....
10	.....	3.3	1.9	1.2	.7	.5	.5	.....
11	.....	3.2	1.8	1.1	.8	.5	.5	.....
12	.....	3.1	1.9	1.1	.8	.6	.5	.....
13	.....	3.1	1.8	1.1	.7	.6	.4	.....
14	.....	2.9	1.7	1.1	.7	.5	.4	.....
15	.....	3.0	1.6	1.0	.6	.5	.4	.....
16	.....	3.0	1.6	1.0	.6	.5	.4	.....
17	.....	2.8	1.6	1.0	.6	.5	.4	.....
18	.....	2.5	1.6	1.0	.6	.5	.4	.....
19	.....	2.4	1.6	1.0	.6	.7	.5	.....
20	.....	2.4	1.6	1.0	.6	.6	.4	.....
21	.....	2.3	1.6	1.0	.7	.6	.4	.....
22	1.1	2.3	1.5	.9	.6	.5	.4	.....
23	1.1	2.2	1.6	.9	.6	.5	.4	.....
24	1.1	2.2	1.5	.8	.6	.5	.5	.....
25	1.4	2.1	1.5	.8	.6	.5	.4	.....
26	1.4	2.1	1.5	.8	.6	.5	.4	.....
27	2.1	2.0	2.1	.9	.6	.5	.4	.....
28	2.1	2.0	1.6	.8	.6	.5	.4	.....
29	2.1	2.0	1.6	.8	.6	.5	.4	.....
30	2.1	2.0	1.5	.8	.6	.5	.4	.....
31	2.2	.....	1.3	.8	.....	.5	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: May 22 to June 11, indirect method for shifting channels, June 12 to Dec. 4, fairly well defined between 0.6 and 3.5 second-feet.

Monthly discharge of Blodgett Creek near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 22 31	2.2	1.1	1.67	33.1	C.
June	3.4	2.0	2.61	155	C.
July	2.2	1.3	1.72	106	B.
August	1.3	.8	1.03	63.3	B.
September	1.0	.6	.69	41.1	B.
October	.7	.5	.55	33.8	B.
November	.5	.4	.44	26.2	B.
The period	.....	.....	.....	458	

FINLEY CREEK NEAR JOCKO, MONT.

Finley Creek, a tributary of Jocko River, is formed by its East and West Forks, which rise in the Mission Range and unite about one-eighth mile above the gaging stations.

The station, which was established August 19, 1908, is located at the ford 2½ miles south of Jocko and 3½ miles east of Arlee, and is 300 feet south of the Northern Pacific Railway. No ditches of importance are diverted from this creek. A staff gage is nailed to a tree on the right bank near the ford. All measurements are made be wading near the ford.

The stream freezes over in the winter. The gage datum has remained unchanged.

Discharge measurements of Finley Creek near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	Raymond Richards	7.5	13.1	1.46	19.7
May 21	J. E. Stewart	14	26.6	1.70	56.2
June 16	Raymond Richards	16	30.5	2.04	162
July 31	J. E. Stewart	14	18.6	1.48	21.7
Oct. 19	Raymond Richards	10	7.6	1.28	9.0

Daily gage height, in feet, of Finley Creek near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	.....	2.05	.....	1.5	1.3	1.35	1.3
2	.....	.....	2.25	1.7	1.5	1.35	1.3	1.3
3	.....	.....	2.3	1.7	1.45	1.45	1.3	1.3
4	.....	1.65	2.2	1.65	1.5	1.4	1.3	1.3
5	.....	1.7	2.25	1.65	1.45	1.4	1.3	1.3
6	.....	1.7	2.1	1.75	1.45	1.4	1.3	1.3
7	.....	1.7	2.1	1.7	1.45	1.35	1.3	1.3
8	.....	1.7	2.1	1.65	1.45	1.35	1.3	1.3
9	.....	1.65	2.1	1.6	1.45	1.35	1.3	1.3
10	.....	1.65	2.05	1.6	1.45	1.35	1.3	1.3
11	.....	1.65	2.0	1.6	1.4	1.35	1.3	1.3
12	.....	1.65	2.0	1.55	1.4	1.35	1.3	1.3
13	.....	1.65	2.0	1.55	1.4	1.35	1.3	1.3
14	.....	1.65	2.0	1.55	1.4	1.35	1.3	1.3
15	1.45	1.65	2.05	1.5	1.4	1.35	1.3	1.3
16	.....	1.7	2.1	1.5	1.35	1.35	1.3	1.3
17	1.45	1.7	2.05	1.5	1.4	1.35	1.3	1.3
18	.....	.....	2.05	1.5	1.4	1.35	1.3	1.3
19	.....	1.7	2.0	1.5	1.35	1.3	1.3	1.35
20	.....	.....	1.95	1.5	1.35	1.35	1.3	1.35
21	1.7	1.8	1.9	1.5	1.35	1.35	1.3	1.3
22	.....	1.7	1.85	1.5	1.35	1.35	1.3	1.35
23	.....	1.7	1.85	1.45	1.35	1.35	1.3	1.45
24	.....	1.7	1.8	1.45	1.35	1.35	1.3	1.45
25	.....	1.85	1.8	1.45	1.35	1.35	1.3	1.4
26	1.5	1.9	1.8	1.45	1.3	1.35	1.3	1.4
27	.....	2.0	1.75	1.7	1.35	1.3	1.3	1.4
28	.....	2.1	1.75	1.6	1.3	1.3	1.3	1.35
29	.....	2.05	1.75	1.55	1.3	1.35	1.3	1.35
30	1.55	1.95	1.75	1.55	1.3	1.35	1.3	1.35
31	.....	1.9	.....	1.5	1.3	.....	1.3	.....

Daily discharge, in second-feet, of Finley Creek near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	34	166	62	24	9.3	12.0	9.3
2	.....	38	248	56	24	12.0	9.3	9.3
3	.....	42	269	56	19.4	19.4	9.3	9.3
4	.....	46	226	46	24	14.8	9.3	9.3
5	.....	56	248	46	19.4	14.8	9.3	9.3
6	.....	56	185	68	19.4	14.8	9.3	9.3
7	.....	56	185	56	19.4	12.0	9.3	9.3
8	.....	56	185	46	19.4	12.0	9.3	9.3
9	.....	46	185	37	19.4	12.0	9.3	9.3
10	.....	46	166	37	19.4	12.0	9.3	9.3
11	.....	46	146	37	14.8	12.0	9.3	9.3
12	.....	46	146	30	14.8	12.0	9.3	9.3
13	.....	46	146	30	14.8	12.0	9.3	9.3
14	.....	46	146	30	14.8	12.0	9.3	9.3
15	19.4	46	166	24	14.8	12.0	9.3	9.3
16	19.4	56	185	24	12.0	12.0	9.3	9.3
17	19.4	56	166	24	14.8	12.0	9.3	9.3
18	28	56	166	24	14.8	12.0	9.3	9.3
19	37	56	146	24	12.0	9.3	9.3	12.0
20	46	68	128	24	12.0	12.0	9.3	12.0
21	56	80	110	24	12.0	12.0	9.3	9.3
22	50	56	95	24	12.0	12.0	9.3	12.0
23	43	56	95	19.4	12.0	12.0	9.3	19.4
24	37	56	80	19.4	12.0	12.0	9.3	19.4
25	30	95	80	19.4	12.0	12.0	9.3	14.8
26	24	110	80	19.4	9.3	12.0	9.3	14.8
27	25	146	68	56	12.0	9.3	9.3	14.8
28	27	185	68	37	9.3	9.3	9.3	12.0
29	29	166	68	30	9.3	12.0	9.3	12.0
30	30	128	68	30	9.3	12.0	9.3	12.0
31	.....	110	.....	24	9.3	.....	9.3	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 9 and 160 second-feet. Discharges interpolated for missing days Apr. 15 to July 2.

Monthly discharge of Finley Creek near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 15–30	56	19.4	32.5	1,030	B.
May	185	34	70.5	4,330	B.
June	269	68	147	8,750	B.
July	62	19.4	35.0	2,150	B.
August	24	9.3	15.0	922	B.
September	19.4	9.3	12.2	726	B.
October	12.0	9.3	9.39	577	C.
November	19.4	9.3	11.1	660	B.
The period	.....	.....	.....	19,100	

EAST FINLEY CREEK NEAR JOCKO, MONT.

East Finley, a small creek rising in the Mission Range and fed by melting snow in the mountains, unites with the West Fork to form Finley Creek.

The station, which was established August 18, 1908, to obtain data for irrigation, is 4 miles southeast of Jocko, 4½ miles east of Arlee, and is located just above the intake of the Indian ditch. This ditch is the only diversion and in low water takes practically the entire flow of the stream. The staff gage is permanent and the datum has remained unchanged. Measurements are made by wading.

Discharge measurements of East Finley Creek near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	Raymond Richards	10	5.2	1.21	4.3
May 21	J. E. Stewart	11	14.6	1.83	22.4
June 16	Raymond Richards	16	22.3	2.48	83.4
July 31	J. E. Stewart	11	12.6	1.80	19.2
Oct. 19	Raymond Richards	.....	.....	1.37	4.4

Daily gage height, in feet, of East Finley Creek near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	2.52	.....	1.78	1.43	1.44	1.33	1.41
2	.....	.....	2.82	2.02	1.73	1.44	1.44	1.34	1.40
3	.....	.....	2.84	2.00	1.69	1.59	1.43	1.34	1.39
4	.....	1.57	2.67	1.99	1.69	1.55	1.42	1.35	1.38
5	.....	1.65	2.70	1.97	1.67	1.53	1.42	1.36	.....
6	.....	1.60	2.50	2.19	1.63	1.51	1.41	1.39	.....
7	.....	1.53	2.39	2.15	1.61	1.49	1.42	1.39	.....
8	.....	1.50	2.28	2.04	1.60	1.47	1.41	1.39	.....
9	.....	1.50	2.28	1.98	1.59	1.45	1.41	1.38	.....
10	.....	1.53	2.23	1.95	1.58	1.45	1.40	1.39	.....
11	.....	1.53	2.20	1.91	1.57	1.48	1.40	1.40	.....
12	.....	1.52	2.21	1.91	1.57	1.49	1.39	1.39	.....
13	.....	1.52	2.29	1.88	1.56	1.48	1.39	1.38	.....
14	.....	1.53	2.46	1.86	1.53	1.46	1.38	1.35	.....
15	1.21	1.55	2.51	1.82	1.51	1.44	1.38	1.34	.....
16	.....	1.68	2.55	1.80	1.50	1.44	1.38	1.35	.....
17	1.21	1.58	2.46	1.79	1.49	1.44	1.37	1.37	.....
18	.....	1.57	2.46	1.76	1.49	1.44	1.37	1.36	.....
19	.....	.....	2.42	1.73	1.48	1.33	1.37	1.37	.....
20	.....	.....	2.35	1.74	1.47	1.44	1.38	1.37	.....
21	.....	1.84	2.28	1.72	1.49	1.45	1.37	1.36	.....
22	.....	1.85	2.20	1.69	1.47	1.44	1.37	1.38	.....
23	.....	1.84	2.13	1.67	1.47	1.43	1.36	1.41	.....
24	.....	1.84	2.10	1.67	1.46	1.43	1.35	1.45	.....
25	.....	2.21	2.10	1.66	1.45	1.43	1.35	1.45	.....
26	1.27	2.37	2.09	1.68	1.45	1.42	1.35	1.44	.....
27	.....	2.56	2.04	1.90	1.47	1.42	1.34	1.43	.....
28	.....	2.57	2.03	1.95	1.44	1.41	1.34	1.42	.....
29	.....	2.47	2.03	1.91	1.43	1.43	1.33	1.41	.....
30	1.31	2.26	2.12	1.88	1.43	1.44	1.34	1.41	.....
31	.....	2.17	.....	1.80	1.42	.....	1.33	.....	.....

Daily discharge, in second-feet, of East Finley Creek near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.9	88	38	19	6.3	6.5	4.1	5.8
2	.....	8.5	129	34	17	6.5	6.5	4.3	5.5
3	.....	10.1	132	33	15	11	6.3	4.3	5.3
4	.....	11.7	108	32	15	9.7	6.0	4.5	5.1
5	.....	14.3	112	31	14	9.1	6.0	4.7	.....
6	.....	12.6	85	48	14	8.4	5.8	5.3	.....
7	.....	10.6	71	44	12	7.8	6.0	5.3	.....
8	.....	9.7	58	36	11	7.3	5.8	5.3	.....
9	.....	9.7	58	32	11	6.8	5.8	5.1	.....
10	.....	10.6	52	30	11	6.8	5.5	5.3	.....
11	.....	10.6	49	27	10	7.6	5.5	5.5	.....
12	.....	10.3	50	27	10	7.8	5.3	5.3	.....
13	.....	10.3	59	25	10	7.6	5.3	5.1	.....
14	.....	10.6	80	24	9.1	7.1	5.1	4.5	.....
15	3.6	11.2	86	21	8.4	6.5	5.1	4.3	.....

Daily discharge, in second-feet, of East Finley Creek near Jocko, Mont., for 1909.—Cont'd.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.6	15.3	92	20	8.1	6.5	5.1	4.5	.....
17	3.6	12	80	20	7.8	6.5	4.9	4.9	.....
18	3.7	11.7	80	18	7.8	6.5	4.9	4.7	.....
19	3.8	15	75	17	7.6	4.1	4.9	4.9	.....
20	3.9	18	66	17	7.3	6.5	5.1	4.9	.....
21	4.0	22	58	16	7.8	6.8	4.9	4.7	.....
22	4.1	22	49	15	7.3	6.5	4.9	5.1	.....
23	4.2	22	43	14	7.3	6.3	4.7	5.8	.....
24	4.3	22	40	14	7.1	6.3	4.5	6.8	.....
25	4.4	50	40	14	6.8	6.3	4.5	6.8	.....
26	4.6	68	39	14	6.8	6.0	4.5	6.5	.....
27	4.8	93	35	26	7.3	6.0	4.3	6.3	.....
28	5.0	94	34	30	6.5	5.8	4.3	6.0	.....
29	5.2	81	34	27	6.3	6.3	4.1	5.8	.....
30	5.3	56	42	25	6.3	6.5	4.3	5.8	.....
31	.....	46	.....	20	6.0	.....	4.1	.....	.....

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 15 to June 30, well defined between 4 and 22 second-feet. July 1 to Dec. 4 curve fairly well defined. Discharges Apr. 16, 18 to 25, 27 to 29, May 1 to 3, and 19 to 20, interpolated.

Monthly discharge of East Finley Creek near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 15-30	5.3	3.6	4.26	135	C.
May	94	6.9	26	1,600	B.
June	132	34	67.5	4,020	B.
July	48	14	25.5	1.570	B.
August	19	6	9.69	596	C.
September	11	4.1	6.97	415	C.
October	6.5	4.1	5.18	318	C.
November	6.8	4.1	5.21	310	C.
The period	.....	.....	.....	8,960	

INDIAN DITCH NEAR JOCKO, MONT.

This station, which was established August 18, 1908, is located on the ditch just below its intake, 50 feet below the gage on East Finley Creek. A staff gage is in the flume and measurements can be made there or in the ditch. The data obtained are to determine the amount of water now used in the ditch. The ditch is about 4 miles long and irrigates land in the vicinty of Jocko Agency. During the irrigating season the ditch carries about 6 second-feet.

Discharge measurements of Indian ditch near Jocko, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	R. Richards	7	2.3	0.12	2.0
May 21	J. E. Stewart	4.8	3.6	.65	14.4
June 16	R. Richards	4.9	4.4	.76	14.0
July 31	J. E. Stewart	4.8	3.8	.67	13.6
Oct. 19	R. Richards	4.7	2.1	.29	3.7

Daily gage height, in feet, of Indian ditch near Jocko, Mont., for 1909.

[Tony Delaware, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	0.15	.....	0.64	0.35	0.36	0.28	0.32
2	.....	.....	.15	0.61	.58	.37	.36	.28	.31
3	.....	.....	.15	.82	.56	.47	.35	.28	.30
4	.....	0.40	.37	.82	.55	.44	.34	.29	.....
5	.....	.53	.37	.80	.53	.43	.34	.30	.....
6	.....	.48	.34	.90	.50	.41	.33	.33	.....
7	.....	.42	.30	.86	.50	.39	.34	.33	.....
8	.....	.38	.27	.82	.49	.38	.33	.31	.....
9	.....	.38	.54	.80	.48	.36	.33	.31	.....
10	.....	.42	.53	.79	.47	.36	.33	.32	.....
11	.....	.40	.50	.78	.46	.39	.33	.33	.....
12	.....	.40	.52	.76	.46	.40	.32	.31	.....
13	.....	.40	.57	.73	.44	.39	.32	.30	.....
14	.....	.42	.58	.71	.42	.37	.32	.28	.....
15	.....	.42	.75	.68	.41	.35	.32	.28	.....
16	.....	.45	.77	.63	.40	.35	.32	.28	.....
17	0.12	.43	.74	.61	.40	.35	.32	.29	.....
18	.....	.....	.74	.57	.40	.35	.31	.29	.....
19	.....	.50	.85	.54	.39	.33	.31	.30	.....
20	.....	.....	.84	.54	.38	.34	.30	.30	.....
21	.....	.65	.81	.52	.40	.35	.29	.29	.....
22	.....	.66	.75	.50	.38	.34	.29	.30	.....
23	.....	.65	.67	.50	.38	.33	.29	.31	.....
24	.....	.65	.63	.50	.37	.33	.28	.34	.....
25	.....	.87	.63	.49	.36	.33	.28	.34	.....
26	.13	.95	.62	.52	.36	.32	.28	.34	.....
27	.....	1.05	.59	.77	.38	.32	.28	.33	.....
28	.....	.10	.57	.79	.36	.32	.28	.33	.....
29	.....	.20	.57	.77	.35	.34	.28	.33	.....
30	.24	.....	.78	.75	.34	.36	.28	.32	.....
31	.....	.....	.....	.67	.33	.....	.27	.....	.....

Daily discharge, in second-feet, of Indian ditch near Jocko, Mont., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.7	2.0	14.4	12.5	4.8	5.0	3.5	4.2
2	.....	4.4	2.0	11.5	10.6	5.2	5.0	3.5	4.0
3	.....	5.1	2.0	18.8	10.0	7.6	4.8	3.5	3.8
4	.....	5.8	5.2	18.8	9.8	6.8	4.6	3.7	.....
5	.....	9.2	5.2	18.0	9.2	6.6	4.6	3.8	.....
6	.....	7.8	4.6	22	8.3	6.0	4.4	4.4	.....
7	.....	6.3	3.8	20	8.3	5.6	4.6	4.4	.....
8	.....	5.4	3.4	18.8	8.0	5.4	4.4	4.0	.....
9	.....	5.4	9.5	18.0	7.8	5.0	4.4	4.0	.....
10	.....	6.3	9.2	17.6	7.6	5.0	4.4	4.2	.....
11	.....	5.8	8.3	17.3	7.3	5.6	4.4	4.4	.....
12	.....	5.8	8.9	16.6	7.3	5.8	4.2	4.0	.....
13	.....	5.8	10.3	15.5	6.8	5.6	4.2	3.8	.....
14	.....	6.3	10.6	14.8	6.3	5.2	4.2	3.5	.....
15	.....	6.3	16.2	13.8	6.0	4.8	4.2	3.5	.....
16	.....	7.0	16.9	12.2	5.8	4.8	4.2	3.5	.....
17	1.8	6.6	15.8	11.5	5.8	4.8	4.2	3.7	.....
18	1.8	7.4	15.8	10.3	5.8	4.8	4.0	3.7	.....
19	1.8	8.3	20	9.5	5.6	4.4	4.0	3.8	.....
20	1.8	10.6	19.6	9.5	5.4	4.6	3.8	3.8	.....
21	1.8	12.8	18.4	8.9	5.8	4.8	3.7	3.7	.....
22	1.8	13.1	16.2	8.3	5.4	4.6	3.7	3.8	.....
23	1.8	12.8	13.4	8.3	5.4	4.4	3.7	4.0	.....
24	1.8	12.8	12.2	8.3	5.2	4.4	3.5	4.6	.....
25	1.8	21	12.2	8.0	5.0	4.4	3.5	4.6	.....
26	1.8	24	11.8	8.9	5.0	4.2	3.5	4.6	.....
27	2.1	28	10.9	16.9	5.4	4.2	3.5	4.4	.....
28	2.4	1.6	10.3	17.6	5.0	4.2	3.5	4.4	.....
29	2.4	2.4	10.3	16.9	4.8	4.6	3.5	4.4	.....
30	3.0	2.0	17.3	16.2	4.6	5.0	3.5	4.2	.....
31	.....	2.0	.....	13.4	4.4	.....	3.4	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined between 2 and 14 second-feet. Discharges interpolated Apr. 18 to 25, 27 to 29; May 1 to 3, 18, 20, and July 1.

Monthly discharge of Indian ditch near Jocko, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 17-30	3.0	1.8	2.02	56	C.
May	28	1.6	8.45	520	B.
June	20	2.0	10.7	637	B.
July	22	8.0	14.2	873	B.
August	12.5	4.4	6.78	417	B.
September	7.6	4.2	5.11	304	B.
October	5.0	3.4	4.08	251	B.
November	4.6	3.5	3.98	237	B.
The period				3,300	

VALLEY CREEK NEAR RAVALLI, MONT.

This station was established August 20, 1908, at the crossing of the highway between Jocko and Ravalli. It is 3 miles east of Ravalli, Mont., 8 miles west of Arlee, and near the mouth of the stream, which is a tributary of Jocko River. It was established in order to obtain comparative results.

Data obtained on this creek are for use in connection with irrigation projects. An ordinary staff gage is located on the left bank above the bridge. Measurements are made by wading.

Discharge measurements of Valley Creek near Ravalli, Mont., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	Raymond Richards	17	16.3	1.26	23.2
May 28	J. E. Stewart	20	60.0	2.50	240
June 17	Raymond Richards	24	52.8	2.22	173
Aug. 4	do	19	16.9	1.37	30.5
Oct. 18	do	17	14.2	1.10	17.4

Daily gage height, in feet, of Valley Creek near Ravalli, Mont., for 1909.

[John Morrigeau, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.4	2.45	1.7	1.4	1.15	1.2	1.15	1.25
2		1.4	2.7	1.7	1.4	1.2	1.2	1.15	1.15
3		1.55	2.7	1.65	1.4	1.45	1.2	1.2	1.25
4		1.8	2.65	1.65	1.35	1.3	1.2	1.25	
5		1.9	2.55	1.65	1.35	1.25	1.2	1.2	
6		1.8	2.4	1.7	1.35	1.2	1.2	1.2	
7		1.75	2.4	1.7	1.35	1.2	1.2	1.2	
8		1.65	2.4	1.65	1.35	1.2	1.2	1.2	
9		1.65	2.35	1.6	1.3	1.2	1.2	1.2	
10		1.7	2.25	1.6	1.3	1.2	1.2	1.2	
11		1.7	2.25	1.6	1.3	1.2	1.2	1.2	
12		1.7	2.25		1.25	1.2	1.2	1.2	
13		1.7	2.2		1.25	1.2	1.2	1.2	
14		1.8	2.2		1.25	1.2	1.2	1.2	
15		1.9	2.3		1.25	1.2	1.15	1.2	

Daily gage height, in feet, of Valley Creek near Ravalli, Mont., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	.....	1.9	2.3	.....	1.25	1.2	1.15	1.2	.....
17	1.25	1.9	2.3	.....	1.25	1.2	1.15	1.2	.....
18	.....	1.9	2.15	.....	1.2	1.2	1.15	1.2	.....
19	.....	1.9	2.15	.....	1.2	1.2	1.2	1.25	.....
20	.....	2.0	2.1	.....	1.2	1.2	1.2	1.3	.....
21	.....	2.05	2.05	.....	1.25	1.2	1.2	1.2	.....
22	.....	2.1	2.0	.....	1.2	1.2	1.2	1.2	.....
23	.....	2.05	1.95	.....	1.2	1.2	1.15	1.4	.....
24	.....	2.0	1.9	.....	1.15	1.25	1.15	1.55	.....
25	.....	2.1	1.85	.....	1.15	1.2	1.15	1.45	.....
26	.....	2.2	1.8	1.5	1.15	1.2	1.15	1.35	.....
27	.....	2.5	1.8	1.6	1.15	1.2	1.15	1.3	.....
28	.....	2.55	1.8	1.55	1.15	1.2	1.15	1.3	.....
29	.....	2.55	1.75	1.5	1.2	1.2	1.15	1.25	.....
30	.....	2.40	1.7	1.45	1.15	1.2	1.15	1.25	.....
31	.....	2.35	.....	1.4	1.15	.....	1.15	.....	.....

NOTE.—Creek reported frozen Nov. 14 to 18 and Dec. 4 to 6. Probably ice conditions for remainder of year.

Daily discharge, in second-feet, of Valley Creek near Ravalli, Mont., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	33	228	69	33	19.1	21	19.1	24
2	33	290	69	33	21	21	19.1	19
3	49	290	62	33	38	21	21	24
4	85	278	62	30	26	21	24	.....
5	103	252	62	30	24	21	21	.....
6	85	216	69	30	21	21	21	.....
7	77	216	69	30	21	21	21	.....
8	62	216	62	30	21	21	21	.....
9	62	204	55	26	21	21	21	.....
10	69	180	55	26	21	21	21	.....
11	69	180	55	26	21	21	21	.....
12	69	180	55	24	21	21	21	.....
13	69	168	54	24	21	21	21	.....
14	85	168	53	24	21	21	21	.....
15	103	192	52	24	21	19.1	21	.....
16	103	192	51	24	21	19.1	21	.....
17	103	192	50	24	21	19.1	21	.....
18	103	156	49	21	21	19.1	21	.....
19	103	156	48	21	21	21	24	.....
20	123	145	47	21	21	21	26	.....
21	134	134	46	24	21	21	21	.....
22	145	123	45	21	21	21	21	.....
23	134	113	44	21	21	19.1	33	.....
24	123	103	43	19.1	24	19.1	49	.....
25	145	94	43	19.1	21	19.1	38	.....
26	168	85	43	19.1	21	19.1	30	.....
27	240	85	55	19.1	21	19.1	26	.....
28	252	85	49	19.1	21	19.1	26	.....
29	252	77	43	21	21	19.1	24	.....
30	216	69	38	19.1	21	19.1	24	.....
31	204	.....	33	19.1	.....	19.1	.....	.....

NOTE.—These discharges are based on a rating curve that is well defined between 18 and 33 second-feet and fairly well defined up to 240 second-feet. Discharges Apr. 18 to 30, July 12 to 25, interpolated. Discharges Nov. 14 to 18 may be affected by ice conditions.

Monthly discharge of Valley Creek near Ravalli, Mont., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April (17-30)	.....	.....	[a] 28.3	786	C.
May	252	33	116	7,130	A.
June	290	69	169	10,100	A.
July	69	33	52.6	3,230	B.
August	33	19.1	24.3	1,490	B.
September	38	19.1	21.9	1,300	B.
October	21	19.1	20.2	1,240	B.
November	49	19.1	24.0	1,430	C.
The period	.....	.....	.....	26,700	

[a] Interpolated.

SPOKANE RIVER DRAINAGE BASIN.

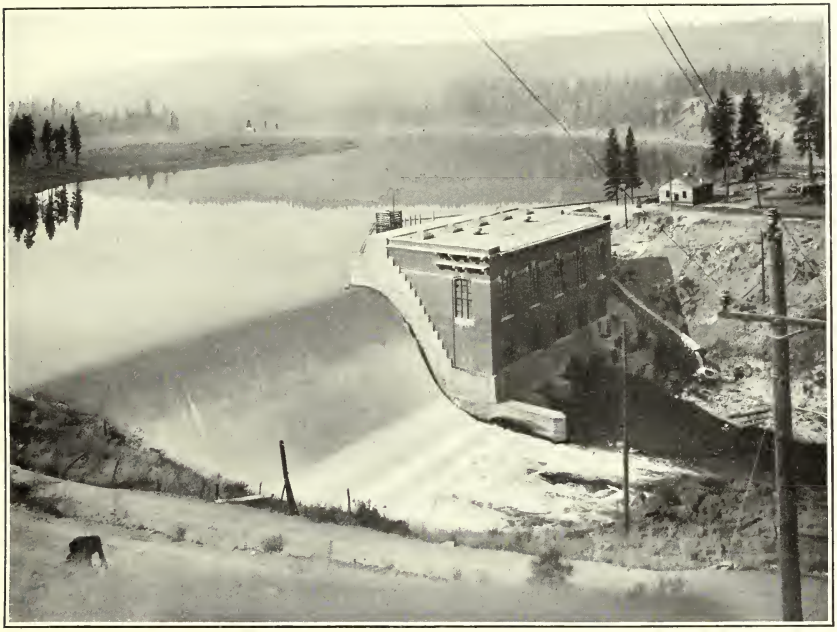
DESCRIPTION.

Spokane River rises in Cœur d'Alene Lake in western Idaho, flows west and northwest and discharges into Columbia River at Fort Spokane, Wash. The principal tributaries received between the lake and the Columbia are Lattah or Hangman Creek, which enters the stream from the south near Spokane, Wash.; Little Spokane River, which comes in from the north about 12 miles below Spokane; and Chamokane Creek, which is tributary from the north and forms the eastern boundary of the Spokane Indian Reservation. Its drainage area comprises about 4,000 square miles. Nearly all of it is heavily forested and a large area is included in the Cœur d'Alene National Forest.

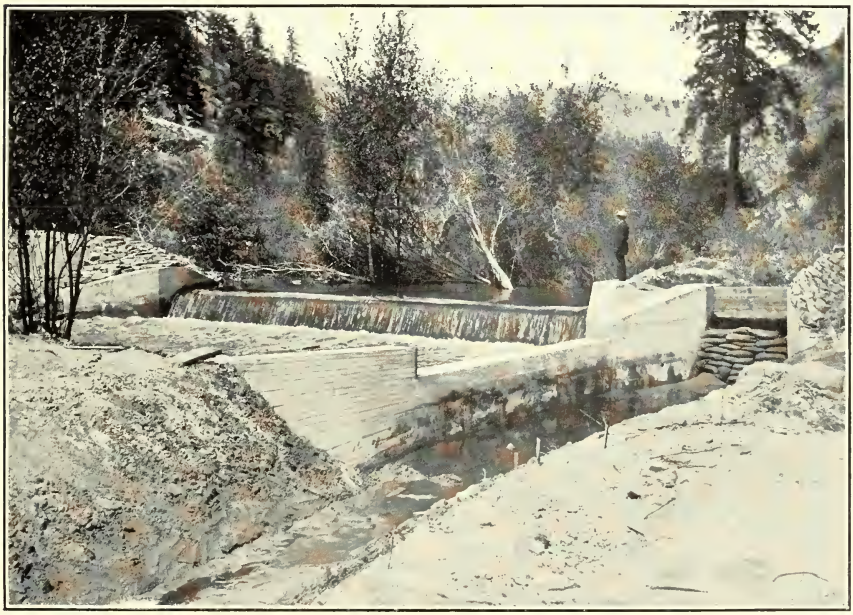
The topography of the country is rugged and broken. The valleys' sides are very steep and many of the peaks rise to regions of perpetual snow.

The mean annual rainfall at Spokane is 17 inches, at St. Maries, 20 inches, and on the summit of the Cœur d'Alene Mountains it is probably 50 inches or more. A large portion of the precipitation, particularly at the higher altitudes, is in the form of snow whose gradual melting helps to feed the streams during the summer season. Occasionally the snow banks are melted suddenly by chinook winds, and when these winds are accompanied by heavy rainfall the flood damage is sometimes great, although its severity is mitigated to a large extent by the natural storage in Cœur d'Alene Lake.

The lands bordering Spokane River are for the most part agricultural. Above Spokane the valley is comparatively wide and level and is underlain throughout with coarse gravel that affords ample ground-water storage from which a liberal supply for irrigation can be drawn. A gravity system diverts water from the right bank of Spokane River at Post Falls. Below Spokane, where the river flows



A. NINEMILE HYDROELECTRIC PLANT OF SPOKANE & INLAND EMPIRE RAILWAY CO. ON SPOKANE RIVER BELOW SPOKANE, WASH.



B. DIVERSION WEIR ON SALMON RIVER FOR OKANOGAN PROJECT, WASHINGTON.

a comparatively deep canyon, the agricultural lands consist of narrow strips along the river banks and are irrigated for the most part by pumping from the river. The lands flanking the canyon of Spokane River are high and are used extensively for wheat raising. The chief products of the region, however, are from its mines.

Cœur d'Alene Lake, which receives the drainage from the western slope of the Cœur d'Alene Mountains occupies a wide valley between two ranges of mountains. Its upper end is within the Cœur d'Alene Indian Reservation. The lands bordering it are for the most part low and swampy, and the lake itself is being gradually filled by sediment brought in by St. Joseph and Cœur d'Alene rivers, its principal tributaries. Undoubtedly, the lake once extended a considerable distance up the valleys of these streams, and for 15 or 20 miles above their mouths the bottom lands are subject annually to overflow, except where the rivers are artificially confined in their channels. Along the immediate banks of the streams the land is relatively higher than that nearer the hills. The channels of the rivers are comparatively deep and are favorable for navigation. The valleys are used more or less for agriculture.

The Spokane affords a large amount of power. At Post Falls, 8 miles below the outlet of Cœur d'Alene Lake, the Washington Water Power Co. has constructed a dam and power plant. The crest of this dam is at elevation 2,116.5 feet above sea level and is provided with a bear-trap dam 100 feet in length by means of which the water can be raised 10 feet above the crest proper. There are also eight Tainter gates which, when opened, afford an additional spillway length of 159 feet. The company's overflow privileges do not allow them to raise the height of water in Cœur d'Alene Lake above an elevation of 2,126 feet. During floods, therefore, the Tainter gates are opened and the bear-trap dam is lowered in order to afford as large capacity of outflow as possible. When the water falls to an elevation of 2,126 feet in the lake the bear trap is raised and the Tainter gates are manipulated to maintain the water at this point as nearly as possible. The waters so stored are released through the power houses. The Post Falls plant of the Washington Water Power Co. has a nominal capacity of 15,000 horsepower; the Spokane plant, 12,000 horsepower. The Ninemile plant of the Inland Empire Railway Co. has a capacity of 10,000 horsepower. (See Pl. IV, *A*.) At Little Falls the Washington Water Power Co. is just completing a plant for a development of 20,000 horsepower. Another plant is projected at a favorable point 14 miles below Little Falls, and still another at the Narrows at the mouth of the river near Fort Spokane. At both of these places plants of 20,000 horsepower capacity could be constructed.

CŒUR D'ALENE LAKE AT CŒUR D'ALENE, IDAHO.

A gage was established in this lake February 15, 1905, at Cœur d'Alene, Idaho, by the United States Geological Survey. The records were suspended on September 30, 1905, by the Survey, but the Washington Water Power Co. has maintained gage readings here since that time. Since April 26, 1903, the St. Joe Boom Co. has kept gage records at their sorting gap at Chatcolet at the mouth of St. Joseph River.

The zero of the United States Geological Survey gage is 2,119.75 feet above sea level and the same datum has been used by the Washington Water Power Co. The St. Joe Boom Co.'s gage is at an arbitrary datum. Comparison of records for 1906–7 indicates that the zero of this gage is 2,118.80 feet above sea level. On December 28 and 29, 1909, a comparison of the Washington Water Power Co.'s gage and the St. Joe Boom Co.'s gage indicates the zero of latter gage to be 2,118.55 feet. Such comparisons are not as reliable as could be desired on account of wind effect on the lake and the gradual rising and falling of the lake surface. The Washington Water Power Co. has used 2,118.7 as the zero of the Boom Co.'s gage, and this elevation is probably as nearly correct as can be determined without running a very expensive level line over the mountains or installing self-registering gages.

All gage heights observed from the St. Joe Boom Co.'s gage from April 26, 1903, to February 14, 1905, had been reduced to the datum of the United States Geological Survey gage. Add 2,100 feet for sea-level elevation. Gage records have been furnished by the St. Joe Boom Co. and the Washington Water Power Co.

Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1903–1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.									
1		29.2	29.1	25.7					22.3
2		29.2	29.6	25.6			20.5		23.3
3			30.6						23.6
4		29.0	30.6	25.2					23.9
5		29.0	30.9	24.9					24.0
6		29.1	31.1	24.9					
7		29.3	31.0	24.7				21.0	
8		29.4	30.9	24.6	21.4				
9		28.7	30.8	24.4		20.7		21.5	
10		29.8		24.2				21.7	23.8
11		29.7	30.7	24.2				21.8	
12		28.7	30.5	24.0					23.6
13		23.4	30.4	23.9				21.9	
14		29.5	30.3	23.7					23.4
15		29.7	30.0	23.6					
16		30.2	29.9	23.5					
17		30.5	29.6	23.3					
18		30.7	29.4	23.2					
19		30.6	29.2	23.1				21.7	23.2
20		30.4	28.9	23.0					

Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1903–1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1903.									
21	.....	30.2	28.6	22.9	.....	.....	.....	.....	.....
22	.....	29.9	28.3	22.8	20.8	.....	.....	21.9	.....
23	.....	29.7	28.0	22.7	.....	.....	.....	.....	.....
24	.....	29.5	27.8	.....	.....	.....	.....	22.2	.....
25	.....	29.1	27.5	.....	.....	.....	.....	.....	.....
26	28.0	29.0	27.2	.....	.....	.....	.....	.....	23.0
27	28.9	28.9	26.9	.....	20.9	.....	.....	.....	.....
28	.....	28.9	26.5	.....	.....	.....	.....	.....	.....
29	.....	29.0	26.4	22.2	20.9	20.7	.....	22.3	.....
30	.....	28.9	26.1	.....	.....	.....	.....	.....	22.7
31	.....	.....	.....	.....	.....	.....	.....	.....	.....

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
1	22.6	.....	.....	.....	32.6	29.2	24.5	21.4	20.3	20.0	20.1	20.4
2	22.5	22.2	.....	.....	32.6	29.1	24.2	21.3	20.2	20.0	20.1	20.4
3	22.5	22.1	.....	.....	32.4	29.0	24.3	21.2	20.2	20.0	20.1	20.4
4	22.4	22.0	22.5	24.9	32.2	28.9	24.1	21.2	20.2	20.0	20.1	20.4
5	.....	.....	.....	.....	32.0	28.7	.....	21.1	20.2	20.0	20.1	20.4
6	.....	.....	22.5	25.2	31.9	28.5	23.8	21.1	20.2	20.0	20.1	20.4
7	22.2	.....	22.6	25.6	31.7	28.4	23.7	20.9	20.1	20.0	20.0	20.3
8	22.1	21.9	23.2	25.8	31.5	28.5	23.5	20.9	20.1	20.0	20.0	20.3
9	.....	21.9	24.3	25.9	31.2	28.2	23.4	20.9	20.1	20.0	20.0	20.3
10	.....	.....	25.5	26.2	30.9	28.1	23.3	20.9	20.1	19.9	20.0	20.3
11	.....	21.8	26.0	26.7	30.8	28.0	23.2	20.8	20.1	19.9	20.1	20.4
12	.....	.....	26.1	27.3	30.5	27.9	23.1	20.8	20.1	19.9	20.1	20.4
13	21.9	.....	26.2	28.1	30.4	27.6	22.9	20.8	20.1	20.0	20.1	20.4
14	.....	.....	.....	29.0	30.2	27.4	22.8	20.7	20.1	20.0	20.0	20.5
15	22.1	21.7	.....	30.2	.....	27.2	22.7	20.7	20.1	20.0	20.0	20.5
16	22.3	.....	.....	31.4	30.2	27.0	22.6	20.7	20.0	20.1	20.0	20.5
17	22.5	.....	26.1	32.3	30.1	26.9	22.5	20.6	20.0	20.1	20.0	20.5
18	22.6	.....	26.0	.....	30.0	.....	22.5	20.6	20.0	20.1	20.0	20.5
19	22.8	.....	25.9	32.7	30.0	26.7	22.5	20.6	20.0	20.1	20.1	20.5
20	.....	.....	25.9	32.7	30.0	26.5	22.4	20.5	20.0	20.1	20.1	20.5
21	.....	.....	25.9	32.7	30.0	26.3	22.2	20.5	20.0	20.1	20.1	20.5
22	.....	.....	25.8	32.8	30.0	26.1	22.3	20.4	20.0	20.1	20.2	20.5
23	.....	.....	25.7	32.8	30.1	25.9	22.1	20.4	20.0	20.1	20.2	20.5
24	.....	21.9	25.6	32.7	30.3	25.8	22.1	20.3	20.0	20.1	20.3	20.5
25	22.7	22.0	25.5	32.4	30.4	25.6	21.9	20.3	20.0	20.1	20.4	20.5
26	22.6	22.0	25.4	.....	30.3	25.4	21.8	20.3	20.0	20.1	20.4	20.5
27	22.5	22.1	25.1	31.9	30.1	25.2	21.8	20.3	20.0	20.1	20.4	20.5
28	.....	22.3	24.9	31.9	29.8	24.9	21.7	20.4	20.0	20.1	20.4	20.5
29	.....	22.4	24.8	.....	29.6	25.2	21.6	20.3	20.0	20.1	20.4	20.5
30	22.4	.....	.....	32.4	29.4	24.6	21.5	20.3	20.0	20.1	20.4	20.5
31	22.3	.....	.....	.....	29.3	.....	21.5	20.3	.....	20.1	.....	20.6
1905.												
1	20.8	20.9	21.3	24.0	24.85	24.95	22.85	20.8	20.1	20.0	21.1	21.0
2	20.8	21.0	21.5	23.95	24.75	24.95	22.8	20.75	20.05	20.2	21.1	21.0
3	20.8	20.9	21.6	23.85	24.6	24.95	22.7	20.75	20.05	20.5	21.1	21.0
4	20.8	20.9	21.8	23.75	24.5	24.95	22.65	20.7	20.05	20.6	21.1	21.0
5	20.9	20.9	21.95	23.65	24.4	25.05	22.55	20.7	20.05	20.7	.....	21.0
6	20.8	20.9	22.1	23.65	24.2	25.15	22.45	20.65	20.05	20.8	21.1	21.0
7	20.8	20.9	22.3	23.65	24.1	25.20	22.35	20.6	20.05	20.8	21.0	21.0
8	20.8	20.9	22.4	23.65	24.1	25.2	22.25	20.55	20.0	20.9	21.0	21.0
9	20.8	20.9	22.55	23.7	24.1	25.15	22.15	20.5	20.0	21.1	21.0	21.0
10	20.7	20.8	22.6	23.75	24.2	25.1	22.05	20.45	20.0	21.2	20.9	20.9
11	20.7	20.8	22.7	23.8	24.35	25.0	22.0	20.45	20.0	21.2	20.9	20.9
12	20.7	20.8	22.75	23.8	24.6	24.9	21.9	20.4	19.95	21.1	20.9	20.9
13	20.5	20.7	22.8	23.8	24.7	24.8	21.8	20.4	19.95	21.1	20.9	20.9
14	20.5	20.7	22.8	23.75	24.75	24.65	21.75	20.4	19.95	21.1	20.9	20.9
15	20.5	20.6	22.8	23.7	24.8	24.5	21.7	20.35	19.95	21.2	20.9	20.9

Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1903–1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
16	20.4	20.6	22.75	23.6	24.8	24.4	21.6	20.35	19.95	21.2	20.8	20.9
17	20.4	20.5	22.75	23.6	24.85	24.2	21.55	20.3	19.95	21.2	20.8	20.9
18	20.4	20.5	22.75	23.6	24.9	24.15	21.5	20.3	19.95	21.1	20.8	20.9
19	20.4	20.5	22.9	23.65	24.9	23.95	21.4	20.25	19.95	21.1	20.8	20.9
20	20.4	20.55	23.0	23.75	24.95	23.8	21.35	20.25	19.95	21.1	20.8	20.9
21	20.4	20.55	23.2	23.9	25.0	23.7	21.3	20.25	19.95	21.1	20.8	20.9
22	20.4	20.55	23.3	24.0	25.0	23.55	21.35	20.25	19.95	21.1	20.8	20.9
23	20.5	20.6	23.4	24.2	25.0	23.5	21.2	20.2	19.95	21.0	20.8	20.9
24	20.5	20.7	23.5	24.3	25.05	23.4	21.2	20.2	19.9	21.0	20.8	20.9
25	20.5	20.8	23.6	24.5	25.0	23.3	21.15	20.2	19.9	21.0	20.8	20.8
26	20.5	20.9	23.7	24.7	24.95	23.2	21.1	20.2	19.95	21.1	20.9	20.8
27	20.6	21.0	23.9	24.85	24.9	23.15	21.0	20.2	20.0	21.1	20.9	20.8
28	20.7	21.15	24.0	25.0	24.9	23.1	20.95	20.2	20.05	21.2	20.9	20.8
29	20.8	.....	24.1	25.0	24.9	23.0	20.9	20.15	20.1	21.2	21.0	20.8
30	20.9	.....	24.15	24.95	24.9	22.95	20.85	20.1	20.15	21.2	21.0	20.8
31	20.9	.....	24.1	.....	24.9	.....	20.85	20.1	.....	21.1	.....	20.8
1906.												
1	20.8	21.9	24.6	25.3	28.2	25.5	23.0	21.0	20.25	20.0	19.9	24.95
2	20.8	22.0	24.7	25.7	28.0	25.6	22.95	20.95	20.25	20.0	19.9	24.9
3	20.7	22.2	24.7	25.9	27.8	25.6	22.85	20.95	20.2	20.0	19.9	24.85
4	20.7	22.4	24.6	26.3	27.7	25.6	22.75	20.9	20.2	20.0	20.0	24.75
5	20.7	22.5	24.5	26.4	27.7	25.6	22.56	20.9	20.2	20.0	20.1	24.7
6	20.7	22.5	24.5	26.5	28.7	25.55	22.55	20.85	20.15	19.95	20.2	24.65
7	20.7	22.5	24.4	26.6	28.6	25.5	22.50	20.85	20.15	19.95	20.6	24.6
8	20.7	22.4	24.3	26.6	27.5	25.4	22.4	20.85	20.15	19.95	20.95	24.6
9	20.7	22.4	24.2	27.6	27.2	25.3	22.3	20.85	20.1	19.95	21.45	24.6
10	20.8	22.4	24.2	27.5	27.0	25.2	22.3	20.8	20.1	19.95	22.0	24.6
11	20.8	22.3	24.1	27.6	26.9	25.1	22.2	20.75	20.1	19.95	22.50	24.55
12	20.8	22.3	24.1	27.7	26.9	25.1	22.1	20.7	20.1	19.95	23.20	24.55
13	20.8	22.2	24.1	27.8	26.8	25.0	22.0	20.7	20.1	19.95	23.7	24.55
14	20.8	22.1	24.0	27.7	26.8	24.9	21.9	20.7	20.1	19.9	24.1	24.55
15	20.9	22.1	24.0	27.7	26.7	24.8	21.9	20.7	20.1	19.9	24.50	24.5
16	20.9	22.1	24.0	27.6	26.5	24.7	21.9	20.7	20.1	19.9	25.0	24.5
17	20.9	22.1	23.8	27.6	26.4	24.6	21.8	20.65	20.1	19.9	25.35	24.5
18	20.9	22.1	23.6	27.7	26.2	24.5	21.75	20.6	20.05	19.9	25.6	24.5
19	20.9	22.1	23.4	27.7	26.0	24.4	21.7	20.6	20.05	19.9	25.55	24.45
20	20.9	23.2	23.3	27.8	25.8	24.3	21.6	20.55	20.05	19.9	25.40	24.45
21	20.9	23.5	23.2	27.8	25.7	24.15	21.65	20.55	20.05	19.9	25.25	24.5
22	20.9	23.8	23.1	27.9	25.6	24.05	21.55	20.5	20.05	19.9	25.15	24.6
23	20.9	24.2	23.0	28.2	25.5	23.9	21.5	20.5	20.05	19.9	25.7	24.75
24	20.9	24.4	23.0	28.5	25.4	23.8	21.4	20.45	20.05	19.9	25.65	24.9
25	21.0	24.6	23.0	28.7	25.2	23.7	21.4	20.45	20.0	19.9	25.55	25.1
26	21.2	24.6	23.2	28.9	25.05	23.6	21.3	20.4	20.0	19.9	25.40	25.3
27	21.4	24.8	23.5	28.8	25.05	23.5	21.25	20.4	20.0	19.9	25.30	25.7
28	21.5	24.8	23.8	28.6	25.1	23.4	21.2	20.35	20.0	19.9	25.2	25.9
29	21.6	.....	24.2	28.4	25.15	23.25	21.2	20.3	20.0	19.9	25.1	26.0
30	21.7	.....	24.5	28.3	25.25	23.15	21.15	20.3	20.0	19.9	25.0	26.05
31	21.8	.....	24.8	.....	25.4	.....	21.1	20.25	.....	19.9	.....	26.1
1907.												
1	26.1	22.35	27.25	26.25	28.45	29.35	25.55	24.35	23.6	22.85	21.55	20.85
2	25.95	22.45	27.25	26.25	28.25	29.3	25.5	24.30	23.6	22.8	21.5	20.85
3	25.85	22.55	27.2	26.25	28.10	29.2	25.45	24.3	23.6	22.75	21.45	20.85
4	25.8	22.65	26.95	26.3	28.0	29.15	25.4	24.25	23.55	22.75	21.45	20.85
5	25.75	22.7	26.75	26.45	27.95	29.05	25.35	24.25	23.55	22.65	21.45	20.85
6	25.65	22.75	26.55	26.6	28.0	28.9	25.3	24.2	23.55	22.65	21.45	20.85
7	25.45	22.8	26.3	26.7	28.05	28.65	25.15	24.15	23.5	22.6	21.4	20.85
8	25.25	23.0	26.1	26.8	28.10	28.5	25.05	24.15	23.5	22.6	21.25	20.95
9	25.0	23.04	25.9	26.9	28.2	28.35	24.9	24.15	23.5	22.5	21.20	21.0
10	24.75	24.0	25.8	27.0	28.5	28.15	24.8	24.15	23.45	22.45	21.15	21.05
11	24.55	24.6	25.8	27.30	28.9	27.95	24.7	24.10	23.4	22.4	21.10	21.1
12	24.3	25.0	25.75	27.7	29.3	27.75	24.6	24.05	23.35	22.4	21.00	21.1
13	24.05	25.3	25.65	28.05	29.6	27.6	24.45	24.0	23.45	22.35	20.9	21.15
14	23.0	25.35	25.6	28.40	29.75	27.4	24.3	24.0	23.45	22.3	20.85	21.2
15	23.7	25.35	25.5	28.75	29.75	27.2	24.25	23.95	23.45	22.25	20.8	21.35

Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1903–1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	23.5	25.35	25.4	29.15	29.75	26.95	24.15	23.9	23.45	22.2	20.8	21.3
17	23.35	25.35	25.2	29.45	29.8	26.8	24.15	23.9	23.45	22.15	20.75	21.3
18	23.25	25.40	25.1	29.75	30.0	26.6	24.20	23.85	23.30	22.10	20.7	21.3
19	23.15	25.40	25.1	29.75	30.35	26.4	24.25	23.8	23.3	22.05	20.7	21.25
20	23.05	25.35	25.3	29.75	30.6	26.35	24.30	23.75	23.25	22.05	20.65	21.20
21	22.95	25.35	25.8	29.6	30.8	26.2	24.35	23.75	23.25	22.0	20.65	21.15
22	22.9	25.4	26.5	29.45	30.95	26.15	24.35	23.75	23.25	22.0	20.65	21.2
23	22.85	25.5	27.05	29.35	30.95	26.1	24.35	23.70	23.2	21.9	20.65	21.15
24	22.75	25.65	27.25	29.25	30.8	26.05	24.4	23.65	23.2	21.85	20.7	21.15
25	22.65	25.85	27.25	29.3	30.65	25.95	24.4	23.65	23.1	21.85	20.75	21.2
26	22.55	26.3	27.20	29.25	30.45	25.8	24.4	23.65	23.1	21.8	20.7	21.35
27	22.45	26.95	27.10	29.15	30.2	25.7	24.35	23.65	23.1	21.75	20.7	21.4
28	22.45	27.15	26.95	29.05	29.95	25.7	24.35	23.65	23.0	21.7	20.8	21.5
29	22.35	.....	26.75	28.9	29.75	25.65	24.35	23.65	22.95	21.65	20.85	21.55
30	22.35	.....	26.55	28.65	29.6	25.6	24.35	23.65	22.9	21.65	20.85	21.55
31	22.30	.....	26.40	.....	29.45	.....	24.35	23.6	.....	21.60	.....	21.55
1908.												
1	21.6	21.85	22.45	25.9	30.1	27.3	25.6	25.8	24.8	23.9	23.65	23.15
2	21.65	21.85	22.5	25.7	29.9	27.2	25.75	25.8	24.75	23.85	23.7	23.1
3	21.65	21.85	22.5	25.45	29.8	27.1	25.8	25.75	24.7	23.8	23.7	23.05
4	21.65	21.85	22.45	25.25	29.8	27.0	25.9	25.75	24.7	23.8	23.7	23.0
5	21.65	21.9	22.4	25.05	29.8	26.95	25.95	25.7	24.7	23.75	23.7	23.0
6	21.65	21.95	22.35	24.9	29.7	27.0	25.95	25.65	24.6	23.75	23.65	22.95
7	21.7	22.0	22.35	24.8	29.6	27.1	26.0	25.6	24.6	23.7	23.6	22.95
8	21.7	22.0	22.3	24.65	29.7	27.25	26.05	25.55	24.6	23.65	23.55	22.9
9	21.7	22.0	22.2	24.5	29.75	27.3	26.05	25.55	24.55	23.6	23.55	22.9
10	21.7	22.05	22.15	24.45	29.8	27.4	26.05	25.5	24.5	23.6	23.05	22.85
11	21.65	22.05	22.1	24.45	29.8	27.45	26.05	25.45	24.5	23.55	23.45	22.85
12	21.6	22.10	22.1	24.5	29.6	27.5	26.1	25.4	24.45	23.5	23.4	22.85
13	21.55	22.05	22.2	24.8	29.4	27.5	26.1	25.35	24.4	23.5	23.3	22.85
14	21.55	22.0	22.7	25.3	29.2	27.45	26.1	25.3	24.4	23.55	23.3	22.8
15	21.5	21.95	24.0	25.9	28.95	27.4	26.15	25.3	24.4	23.65	23.25	22.75
16	21.55	21.95	25.3	26.4	28.75	27.3	26.15	25.25	24.4	23.8	23.2	22.7
17	21.55	21.95	26.7	27.0	28.6	27.2	26.15	25.25	24.35	23.9	23.2	22.65
18	21.55	22.0	27.6	27.5	28.5	27.0	26.1	25.2	24.35	23.9	23.15	22.6
19	21.55	22.05	28.0	28.0	28.3	26.9	26.1	25.15	24.35	23.9	23.15	22.5
20	21.65	22.05	28.0	28.5	28.2	26.7	26.1	25.15	24.35	23.9	23.15	22.4
21	21.75	22.1	27.8	29.0	28.1	26.5	26.1	25.10	24.3	23.9	23.15	22.35
22	21.85	22.1	27.6	29.7	27.95	26.3	26.1	25.05	24.25	23.85	23.2	22.35
23	21.9	22.1	27.3	30.2	27.85	26.0	26.05	25.0	24.25	23.85	23.2	22.35
24	21.95	22.15	27.1	30.4	27.75	25.85	26.05	25.0	24.2	23.8	23.25	22.3
25	21.95	22.2	26.9	30.7	27.65	25.7	26.05	25.0	24.2	23.75	23.3	22.3
26	21.95	22.2	26.9	30.95	27.65	25.55	26.0	25.0	24.1	23.75	23.3	22.3
27	21.95	22.3	26.85	30.95	27.6	25.5	26.0	24.95	24.05	23.7	23.3	22.25
28	21.95	22.35	26.7	30.8	27.55	25.45	25.95	24.9	24.0	23.65	23.25	22.2
29	21.95	22.45	26.65	30.6	27.5	25.45	25.9	24.85	23.95	23.65	23.2	22.1
30	21.95	.....	26.3	30.4	27.45	25.45	25.85	24.85	23.95	23.65	23.2	22.05
31	21.95	.....	26.15	.....	27.4	.....	25.85	24.85	.....	23.65	.....	22.0
1909.												
1	21.95	24.6	23.8	24.45	26.0	28.45	27.0	26.6	24.95	23.6	22.6	28.8
2	21.95	24.4	23.8	24.6	26.0	28.5	26.95	26.6	24.9	23.55	22.6	28.9
3	22.0	24.25	23.75	24.8	25.95	28.75	26.85	26.5	24.85	23.55	22.7	28.9
4	22.0	24.1	23.75	24.9	26.0	29.0	26.75	26.5	24.8	23.55	22.7	28.8
5	22.05	24.0	23.75	24.95	26.1	29.1	26.7	26.45	24.7	23.5	24.0	28.6
6	22.1	23.9	23.75	24.9	26.6	29.2	26.8	26.4	24.7	23.5	24.4	28.4
7	22.1	23.8	23.7	24.85	26.8	29.15	26.8	26.3	24.6	23.5	24.5	28.1
8	22.15	23.7	23.7	24.8	26.85	29.0	26.7	26.3	24.6	23.5	24.6	27.85
9	22.15	23.65	23.7	24.7	26.85	28.9	26.6	26.3	24.55	23.4	24.7	27.6
10	22.15	23.55	23.65	24.6	26.8	28.7	26.6	26.3	24.5	23.4	24.7	27.4
11	22.1	23.4	23.6	24.6	26.8	28.65	26.6	26.2	24.5	23.35	24.65	27.1
12	22.05	23.3	23.5	24.65	26.75	28.4	26.6	26.2	24.4	23.3	24.65	26.9
13	22.05	23.3	23.4	24.7	26.7	28.2	26.6	26.1	24.3	23.3	24.7	26.8
14	22.05	23.25	23.3	24.7	26.65	28.05	26.6	26.05	24.35	23.25	24.75	26.6
15	22.05	23.3	23.2	24.75	26.55	27.95	26.5	26.05	24.2	23.2	24.85	26.4

Daily gage height, in feet, of Cœur d'Alene Lake at Cœur d'Alene, Idaho, for 1903–1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
16	22.05	23.35	23.15	24.85	26.5	27.9	26.55	26.0	24.2	23.15	24.8	26.2
17	22.1	23.45	23.2	24.85	26.6	27.95	26.55	25.9	24.15	23.1	24.8	26.0
18	22.2	23.7	23.3	24.9	26.7	28.0	26.55	25.8	24.1	23.05	24.9	25.7
19	22.3	23.95	23.4	24.9	26.8	28.0	26.5	25.8	24.0	23.0	25.3	25.45
20	23.0	24.1	23.45	24.95	26.9	28.0	25.6	25.7	24.0	23.0	25.4	25.2
21	24.0	24.2	23.45	25.0	27.0	27.9	26.5	25.65	23.9	22.95	26.2	24.9
22	24.5	24.2	23.4	25.05	27.1	27.9	26.5	25.6	23.9	22.9	26.7	24.7
23	25.0	24.1	23.4	25.1	27.15	27.8	26.5	25.5	23.8	22.9	27.0	24.45
24	25.7	24.0	23.35	25.1	27.2	27.75	26.45	25.5	23.8	22.9	27.5	24.2
25	26.05	23.9	23.4	25.15	27.2	27.7	26.4	25.5	23.8	22.85	28.0	24.0
26	25.95	23.8	23.5	25.20	27.3	27.6	26.4	25.4	23.7	22.8	28.5	23.85
27	25.8	23.75	23.6	25.4	27.6	27.5	26.4	25.3	23.65	22.75	28.8	23.7
28	25.5	23.75	23.8	25.6	27.9	27.4	26.5	25.2	23.65	22.7	28.9	23.6
29	25.25	.....	24.0	25.9	28.2	27.3	26.5	25.1	23.65	22.7	28.85	23.45
30	25.0	.....	24.15	26.0	28.4	27.2	26.5	25.1	23.6	22.65	28.8	23.3
31	24.8	.....	24.1	.....	28.45	.....	26.55	25.0	.....	22.65	.....	23.2

SPOKANE RIVER AT SPOKANE, WASH.

A record of gage heights of Spokane River has been kept by the Washington Water Power Co. at their dam at Spokane, Wash.,[1] since March 22, 1891.

The station was originally established by the United States Geological Survey October 17, 1896, but gage height readings were not begun until October 25, 1896. They have been continuous since that date. From October 17, 1896, to July 8, 1903, the station was at the Oregon Railroad & Navigation Co.'s railway bridge. From July 8, 1903, to March 30, 1904, it was located at the Olive Avenue Bridge.

The gage at the Olive Avenue Bridge was set to read the same as the one at the Oregon Railroad & Navigation Co.'s bridge, and, although there was a fall of 1.43 feet, the gages did read practically the same between 2.85 and 5 feet. On March 30, 1904, a gage was installed on the south side of the Mission Street Bridge and a cable was installed for making measurements at Martha Street, half a mile above the Mission Street Bridge. The gage at Mission Street was read from March 30, 1904, to March 1, 1907. On April 17, 1905, an auxiliary gage was installed a short distance upstream from the cable at Martha Street. During 1906–7 simultaneous readings were obtained on the Mission and Martha Street gages in order to determine the relation between the two.[2] Since March 1, 1907, the Martha Street gage has been used for daily observations.

At present measurements are made from the cable at Martha Street.

[1] For full description of this station see the Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1896, pp. 359–360. Gage heights from 1891 to 1896, with full notes regarding changes in waste-gate openings and flashboards as furnished by the company, were published in Water-Supply Paper U. S. Geol. Survey No. 11, pp. 85–88.

[2] This table was published in Water-Supply Paper U. S. Geol. Survey No. 252, p. 119.

The conditions at the station are favorable for good results. The banks are not subject to overflow. The bed of the stream is composed of gravel and changes slightly during freshets, but the flow is controlled by a broad riffle above Mission Street. The discharge of the river at this point is greatly influenced by the operation of the power plant at Post Falls. During the summer water is stored in Cœur d'Alene Lake. A dam for this purpose was completed in July, 1906.

The gage heights for 1891–1896, furnished by the Washington Water Power Co., have been revised by applying corrections for manipulation of the waste gates and flashboards and are republished in the following tables. By means of a table of gage relations, determined from simultaneous readings during 1896–1897 for this gage and the United States Geological Survey gage at the Oregon Railroad & Navigation Co.'s bridge and the 1897 rating table,[1] a rating table has been developed which is applicable for the above period. Estimates of discharge for 1891–1896 are published below for the first time. The data for 1897 to 1908 have been published in the regular reports for those years. (See tables on pp. 15–16.) Though many of these data are good, some of them are subject to certain revisions based on later measurements. The revision has not yet been made.

Discharge measurements of Spokane River at Spokane, Wash., in 1896–1900 and 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1896.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 27	C. C. Babb		799	2.00	2,940
Oct. 17	do		590	1.46	1,720
1897.					
May 20	C. C. Babb		4,420	10.80	29,100
June 29	do		2,130	5.16	9,030
July 21	J. Wetzel		1,710	4.05	7,890
Sept. 11	C. C. Babb		807	1.92	2,580
Oct. 20	S. Arnold		690	1.50	2,010
1898.					
Sept. 6	S. Arnold		808	1.80	2,720
Oct. 8	C. C. Babb		717	1.75	2,200
1899.					
June 23	S. Arnold		3,900	9.30	23,300
1900.					
May 17	S. Arnold		2,680	6.50	13,600
June 14	do		1,680	4.10	7,490
1909.					
June 11	Howard Kimble	248	3,550	25.35	16,700
Aug. 16	J. C. Stevens	204	1,760	17.36	1,900
Oct. 21	G. L. Parker	193	1,870	17.51	2,100

NOTE.—The measurements for 1896–1900 were made at the Oregon Railroad & Navigation Co.'s bridge. and those for 1909 were made from the cable at Martha Street.

[1] Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, p. 488.

Corrected daily gage height, in feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891–1896.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1891.												
1	.....	.....	.....	2.08	6.00	4.93	2.70	1.53	.....	.....	1.25	2.33
2	.....	.....	.....	2.08	6.00	4.77	2.78	1.45	.....	.....	1.33	2.50
3	.....	.....	.....	2.17	5.92	4.60	2.78	1.45	.....	.....	1.50	2.50
4	.....	.....	.....	2.17	5.67	4.43	2.70	1.45	.....	.....	1.67	2.50
5	.....	.....	.....	2.17	5.50	4.27	2.70	1.47	.....	.....	1.83	2.58
6	.....	.....	.....	2.17	5.50	4.27	2.70	1.47	.....	.....	1.83	2.58
7	.....	.....	.....	2.17	5.67	4.10	2.53	1.47	.....	.....	1.92	2.58
8	.....	.....	.....	2.50	5.83	4.10	2.53	1.38	.....	.....	1.92	2.58
9	.....	.....	.....	2.75	6.00	4.02	2.45	1.38	.....	.....	2.00	2.58
10	.....	.....	.....	2.92	6.00	3.93	2.45	1.38	.....	.....	2.00	2.58
11	.....	.....	.....	2.92	6.25	3.85	2.45	1.38	.....	.....	2.00	2.58
12	.....	.....	.....	2.92	6.00	3.77	2.45	1.30	.....	.....	2.00	2.50
13	.....	.....	.....	3.17	6.00	3.60	2.37	1.30	.....	.....	2.08	2.50
14	.....	.....	.....	3.33	6.00	3.60	2.37	.....	.....	.....	2.08	2.50
15	.....	.....	.....	3.50	6.00	3.60	2.37	.....	.....	.....	2.17	2.50
16	.....	.....	.....	3.75	6.17	3.52	2.37	.....	.....	.....	2.17	2.50
17	.....	.....	.....	3.92	6.17	3.43	2.28	.....	.....	.....	2.17	2.50
18	.....	.....	.....	4.08	6.25	3.35	2.20	.....	.....	.....	2.25	2.58
19	.....	.....	.....	4.50	6.25	3.27	2.20	.....	.....	.....	2.25	2.58
20	.....	.....	.....	4.92	6.17	3.18	2.20	.....	.....	1.17	2.25	2.58
21	.....	.....	.....	5.50	6.08	3.10	2.12	.....	.....	1.17	2.33	2.58
22	.....	.....	0.58	5.58	6.00	3.10	2.03	.....	.....	1.17	2.33	2.58
23	.....	.....	.92	5.67	5.83	3.02	2.03	.....	.....	1.17	2.33	2.58
24	.....	.....	1.25	5.83	5.83	3.02	1.95	.....	.....	1.17	2.33	2.58
25	.....	.....	1.42	5.83	5.50	2.93	1.87	.....	.....	1.17	2.33	2.58
26	.....	.....	1.58	5.83	5.42	2.85	1.87	.....	.....	1.17	2.33	2.58
27	.....	.....	1.75	5.83	5.25	2.77	1.87	.....	.....	1.17	2.33	2.58
28	.....	.....	1.92	5.83	5.00	2.77	1.70	.....	.....	1.17	2.33	2.58
29	.....	.....	2.00	5.83	5.00	2.77	1.62	.....	.....	1.17	2.33	2.58
30	.....	.....	2.08	6.00	5.00	2.77	1.62	.....	.....	1.17	2.33	2.58
31	.....	.....	2.08	.....	4.83	.....	1.53	.....	.....	1.25	.....	2.58
1892.												
1	2.58	2.33	3.08	5.58	5.52	9.00	5.33	2.58	.....	1.00	1.00	2.00
2	2.42	2.17	3.17	5.42	5.52	9.00	5.25	2.58	.....	1.00	1.00	2.00
3	2.42	2.17	3.25	5.33	5.52	9.00	5.17	.....	.....	1.00	1.00	2.08
4	2.42	2.17	3.33	5.08	5.52	8.92	5.08	.....	.....	1.00	1.00	2.08
5	2.42	2.17	3.42	4.92	5.50	8.83	5.00	.....	.....	1.00	1.00	2.17
6	2.42	2.17	3.50	4.83	5.58	8.67	4.92	.....	.....	1.00	1.00	2.17
7	2.42	2.17	3.50	4.75	5.67	8.58	4.83	.....	.....	1.00	1.00	2.25
8	2.42	2.17	3.50	4.75	5.75	8.42	4.75	.....	.....	1.00	1.00	2.25
9	2.42	2.17	3.58	4.75	5.83	8.25	4.67	.....	.....	1.00	1.00	2.25
10	2.42	2.17	3.67	4.75	5.92	8.00	4.58	.....	.....	1.00	1.00	2.25
11	2.25	2.17	3.83	4.75	6.08	7.75	4.50	.....	.....	1.00	1.00	2.25
12	2.25	2.25	4.00	4.75	6.33	7.65	4.33	.....	.....	1.00	1.00	2.25
13	2.25	2.25	4.33	4.75	6.58	7.58	4.25	.....	.....	1.00	1.00	2.25
14	2.25	2.25	4.67	4.83	6.75	7.50	4.17	.....	.....	1.00	1.00	2.25
15	2.25	2.25	4.92	4.92	6.92	7.33	4.08	.....	.....	1.00	1.00	2.17
16	2.25	2.25	5.17	5.00	7.00	7.25	4.00	.....	.....	1.00	1.08	2.17
17	2.25	2.25	5.33	5.08	7.08	7.08	3.92	.....	.....	1.00	1.17	2.17
18	2.25	2.25	5.50	5.17	7.17	7.00	3.83	.....	.....	1.00	1.17	2.08
19	2.25	2.25	5.67	5.25	7.25	6.83	3.75	.....	.....	1.00	1.25	2.08
20	2.25	2.25	5.75	5.25	7.33	6.67	3.67	.....	1.00	1.00	1.25	2.00
21	2.25	2.25	5.75	5.25	7.42	6.60	3.58	.....	1.00	1.00	1.33	1.92
22	2.25	2.25	5.75	5.25	7.58	6.33	3.50	.....	1.00	1.00	1.33	1.92
23	2.25	2.33	5.67	5.25	7.83	6.25	3.33	.....	1.00	1.00	1.42	1.83
24	2.08	2.50	5.75	5.25	8.00	6.08	3.27	.....	1.00	1.00	1.50	1.83
25	2.08	2.75	5.83	5.25	8.33	6.00	3.00	.....	1.00	1.00	1.58	1.83
26	2.08	2.92	5.83	5.33	8.67	5.83	2.83	.....	1.00	1.00	1.67	1.92
27	2.08	3.00	5.83	5.33	8.75	5.75	2.75	.....	1.00	1.00	1.75	1.92
28	2.08	3.00	5.83	5.33	8.92	5.67	2.67	.....	1.00	1.00	1.83	1.92
29	2.08	3.00	5.83	5.33	9.00	5.58	2.58	.....	1.00	1.00	1.92	2.00
30	2.08	.....	5.83	5.42	9.00	5.50	2.58	.....	1.00	1.00	1.92	2.00
31	2.08	.....	5.75	.....	9.00	.....	2.58	.....	.....	1.00	.....	2.08
1893.												
1	2.08	1.92	1.58	3.50	7.37	9.45	6.45	3.03	1.53	1.25	3.00	2.92
2	2.17	1.83	1.58	3.75	7.53	9.45	6.37	2.95	1.53	1.33	3.00	2.92
3	2.17	1.83	1.58	4.08	7.70	9.45	6.20	2.95	1.53	1.42	2.92	2.83
4	2.25	1.83	1.58	4.33	7.87	9.45	6.20	2.87	1.45	1.50	2.83	2.83
5	2.33	1.75	1.58	4.67	7.95	9.45	6.12	2.87	1.45	1.58	2.83	2.83

Corrected daily gage height, in feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891–1896—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1893.												
6	2.42	1.75	1.58	5.20	8.03	9.20	6.03	2.87	1.37	1.67	2.92	2.83
7	2.50	1.75	1.58	5.62	8.12	9.20	5.95	2.78	1.28	1.83	3.17	2.83
8	2.50	1.75	1.67	5.92	8.20	9.20	5.87	2.78	1.28	2.00	3.67	2.83
9	2.58	1.67	1.67	6.03	8.37	9.20	5.78	2.70	1.20	2.25	4.17	3.17
10	2.58	1.67	1.67	6.28	8.53	9.20	5.62	2.70	1.20	2.50	4.50	3.67
11	2.58	1.58	1.67	6.28	8.70	9.12	5.45	2.70	1.20	2.75	4.67	4.00
12	2.58	1.58	1.67	6.28	8.95	9.03	5.20	2.62	1.25	3.00	4.75	4.83
13	2.58	1.58	.....	6.12	8.95	8.95	5.12	2.62	1.25	3.00	4.83	5.00
14	2.50	1.58	.....	6.12	9.20	8.78	4.95	2.53	1.17	3.00	4.83	5.00
15	2.50	1.58	1.67	5.95	9.45	8.62	4.78	2.45	1.17	3.00	4.83	4.92
16	2.50	1.58	1.67	5.87	9.95	8.45	4.62	2.37	1.17	3.08	4.75	4.83
17	2.42	1.58	1.67	5.70	10.20	8.20	4.45	2.28	1.17	3.08	4.67	4.67
18	2.42	1.58	1.67	5.62	10.45	8.12	4.28	2.20	1.17	3.08	4.50	4.50
19	2.33	1.58	1.67	5.53	11.20	7.95	4.20	2.12	1.17	3.08	4.33	4.33
20	2.25	1.58	1.67	5.45	11.45	7.78	4.12	2.03	1.17	3.17	4.08	4.17
21	2.25	1.58	1.67	5.45	11.45	7.62	4.03	2.03	1.08	3.17	3.83	4.17
22	2.17	1.58	1.75	5.53	11.37	7.53	3.87	1.95	1.08	3.17	3.58	4.17
23	2.17	1.58	1.75	5.62	10.95	7.37	3.70	1.95	1.08	3.17	3.42	4.08
24	2.17	1.58	1.83	5.87	10.70	7.20	3.62	1.87	1.08	3.17	3.25	4.00
25	2.08	1.58	1.83	6.20	10.70	7.20	3.53	1.78	1.08	3.17	3.17	4.00
26	2.08	1.58	2.00	6.62	10.37	7.03	3.37	1.70	1.08	3.17	3.00	3.92
27	2.00	1.58	2.17	6.78	10.20	7.03	3.20	1.62	1.08	3.17	3.00	3.92
28	2.00	1.58	2.42	6.95	9.95	6.87	3.20	1.62	1.08	3.17	3.00	3.92
29	1.92	.....	2.67	7.12	9.70	6.70	3.20	1.62	1.08	3.17	3.00	3.83
30	1.92	.....	2.92	7.20	9.70	6.53	3.20	1.53	1.08	3.08	3.00	3.83
31	1.92	.....	3.25	.....	9.70	.....	3.12	1.53	.....	3.08	.....	3.83
1894.												
1	3.75	3.67	1.75	4.50	10.08	12.33	7.35	4.02	2.10	1.85	2.42	3.50
2	3.75	3.50	1.75	4.83	10.00	12.33	7.27	3.93	2.02	1.85	2.50	3.58
3	3.67	3.33	1.92	5.00	9.83	12.33	7.10	3.85	2.02	1.85	2.58	3.58
4	3.58	3.17	1.92	5.75	9.75	12.25	6.93	3.85	2.02	1.85	2.67	3.58
5	3.50	3.00	1.92	5.83	9.58	12.25	6.77	3.77	2.02	1.85	2.67	3.58
6	3.42	3.00	1.92	5.83	9.50	12.25	6.60	3.68	2.02	1.85	2.75	3.58
7	3.33	2.92	1.92	5.83	9.50	12.08	6.52	3.68	1.93	1.85	2.75	3.50
8	3.25	2.92	2.00	5.83	9.42	11.92	6.35	3.60	1.93	1.85	2.83	3.50
9	3.17	2.83	2.00	5.83	9.42	11.67	6.18	3.52	1.93	1.85	2.92	3.50
10	3.00	2.83	2.00	6.00	9.42	11.33	6.02	3.43	1.93	1.83	3.00	3.50
11	2.83	2.75	2.00	6.00	9.33	10.00	5.93	3.35	1.93	1.83	3.17	3.50
12	2.67	2.67	2.00	6.25	9.25	10.43	5.85	3.27	1.93	1.83	3.25	3.50
13	2.67	2.50	2.00	6.58	9.25	10.27	5.77	3.18	1.85	1.83	3.25	3.33
14	2.75	2.50	2.08	6.92	9.17	10.02	5.68	3.10	1.85	1.75	3.25	3.33
15	3.17	2.50	2.08	7.25	9.08	9.77	5.52	3.02	1.85	1.75	3.25	3.25
16	4.25	2.33	2.08	7.58	9.08	9.60	5.43	2.93	1.85	1.75	3.25	3.17
17	5.00	2.33	2.08	7.67	9.33	9.43	5.27	2.85	1.85	1.75	3.25	3.08
18	5.50	2.17	2.17	7.67	9.58	9.35	5.10	2.77	1.85	1.75	3.25	3.08
19	5.58	2.00	2.17	7.58	9.92	9.27	4.93	2.68	1.85	1.67	3.17	3.00
20	5.58	1.92	2.33	7.50	10.08	9.10	4.85	2.60	1.85	1.67	3.08	3.00
21	5.50	1.83	2.42	7.42	10.17	8.93	4.68	2.52	1.85	1.67	3.00	2.92
22	5.33	1.83	2.58	7.42	10.33	8.85	4.52	2.43	1.85	1.67	3.00	2.92
23	5.00	1.83	2.67	7.42	10.50	8.68	4.43	2.35	1.85	1.67	3.00	2.83
24	4.83	1.75	2.67	7.58	10.75	8.52	4.35	2.35	1.85	1.67	3.00	2.83
25	4.67	1.75	2.67	8.08	11.00	8.35	4.35	2.27	1.85	1.67	3.08	2.75
26	4.42	1.75	2.75	8.42	11.33	8.18	4.27	2.18	1.85	1.83	3.08	2.75
27	4.25	1.75	2.92	8.58	11.67	8.02	4.27	2.18	1.85	2.00	3.08	2.75
28	4.08	1.75	3.08	8.92	12.00	7.85	4.18	2.18	1.85	2.17	3.17	2.67
29	4.00	.....	3.33	9.08	12.17	7.68	4.18	2.18	1.85	2.25	3.25	2.58
30	3.83	.....	3.67	9.08	12.17	7.52	4.10	2.10	1.85	2.33	3.42	2.50
31	.....	.....	4.00	.....	12.42	.....	4.10	2.10	.....	2.33	.....	2.50
1895.												
1	2.42	3.50	4.83	4.17	7.00	6.00	3.33	1.75	1.25	1.00	1.00	1.50
2	2.42	3.42	4.83	4.33	7.17	6.00	3.25	1.75	1.25	1.00	1.00	1.50
3	2.33	3.42	4.92	4.42	7.17	5.83	3.00	1.75	1.25	1.00	1.00	1.50
4	2.33	3.25	5.00	4.50	7.25	5.75	3.00	1.75	1.25	1.00	1.00	1.50
5	2.25	3.17	5.08	4.67	7.25	5.67	3.00	1.67	.....	1.00	1.00	1.50
6	2.25	3.17	5.08	4.67	7.33	5.58	3.00	1.67	.....	1.00	1.08	1.50
7	2.25	3.08	5.00	4.75	7.50	5.58	2.83	1.58	.....	1.00	1.08	1.50
8	2.25	3.00	4.83	4.75	7.50	5.50	2.83	1.58	.....	1.00	1.17	1.50
9	2.25	2.92	4.83	4.75	7.58	5.33	2.75	1.58	.....	1.00	1.17	1.50
10	2.33	2.83	4.75	4.83	7.67	5.00	2.67	1.58	1.00	1.00	1.17	1.50

Corrected daily gage height, in feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891–1896—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895.												
11	2.33	2.83	4.67	4.92	7.67	5.00	2.67	1.58	1.00	1.00	1.17	1.58
12	2.42	2.75	4.50	5.00	7.50	5.00	2.58	1.50	1.08	1.00	1.17	1.58
13	2.67	2.75	4.50	5.00	7.33	5.00	2.58	1.50	1.17	1.00	1.17	1.67
14	3.08	2.67	4.42	5.17	7.00	5.00	2.50	1.42	1.00	1.00	1.17	1.67
15	3.50	2.58	4.42	5.25	7.00	4.67	2.50	1.42	1.00	1.00	1.17	1.67
16	4.00	2.58	4.42	5.33	6.83	4.50	2.42	1.42	1.00	1.00	1.17	1.67
17	4.33	2.58	4.25	5.50	6.75	4.33	2.42	1.42	1.00	1.00	1.17	1.67
18	4.33	2.58	4.17	5.67	6.75	4.25	2.42	.....	1.00	1.00	1.17	1.67
19	4.33	2.50	4.17	5.67	6.67	4.17	2.33	.....	1.00	1.00	1.17	1.67
20	4.33	2.50	4.00	5.75	6.58	4.08	2.33	.....	1.00	1.00	1.17	1.67
21	4.42	2.50	4.00	5.75	6.58	4.00	2.25	.....	1.00	1.00	1.17	1.67
22	4.25	2.50	3.92	5.75	6.58	3.83	2.25	.....	1.00	1.00	1.17	1.67
23	4.25	2.67	3.83	5.83	6.58	3.83	2.17	1.25	1.00	1.00	1.17	1.67
24	4.17	3.17	3.75	5.83	6.50	3.67	2.08	1.25	1.00	1.00	1.17	1.67
25	4.17	3.58	3.75	6.00	6.33	3.58	2.00	1.25	1.00	.....	1.17	1.67
26	4.08	4.00	3.75	6.17	6.33	3.50	2.00	1.25	1.00	.....	1.17	1.67
27	4.00	4.33	3.75	6.50	6.17	3.50	2.00	1.25	1.00	.....	1.25	1.67
28	3.83	4.67	3.67	6.67	6.00	3.50	2.00	1.25	1.00	.....	1.33	1.67
29	3.67	.....	3.67	6.92	6.00	3.50	1.92	1.25	1.00	.....	1.33	1.75
30	3.67	.....	3.67	7.00	6.00	3.50	1.83	1.25	1.00	.....	1.33	1.75
31	3.58	.....	4.00	.....	6.00	.....	1.75	1.25	.....	1.00	.....	1.75
1896.												
1	1.75	4.00	6.33	7.67	7.33	8.42	8.00	3.25	1.83	1.42	1.40	4.70
2	1.75	4.00	6.17	7.50	7.42	8.67	7.83	3.25	1.83	1.42	1.50	4.60
3	1.75	4.00	6.17	7.50	7.42	8.67	7.67	3.17	1.83	1.33	1.50	4.60
4	1.75	4.00	6.00	7.50	7.50	8.75	7.50	3.08	1.75	1.33	1.50	4.70
5	1.83	4.00	6.00	7.33	7.50	8.75	7.33	3.00	1.75	1.33	1.55	5.20
6	1.83	4.00	6.00	7.17	7.58	8.83	7.08	3.00	1.75	1.33	1.55	5.50
7	1.83	4.00	6.00	6.83	7.58	8.92	6.83	2.92	1.67	1.33	1.60	5.60
8	1.83	4.00	6.00	6.83	7.67	8.83	6.58	2.83	1.67	1.33	1.60	5.85
9	1.92	4.00	6.00	6.67	7.67	8.75	6.33	2.83	1.67	1.25	1.65	6.10
10	1.92	4.00	6.00	6.67	7.75	8.75	6.17	2.75	1.67	1.25	1.65	6.30
11	1.92	4.00	6.00	6.67	7.75	8.75	6.00	2.75	1.67	1.25	1.70	6.50
12	1.92	4.00	6.00	6.67	7.75	8.75	5.83	2.67	1.58	1.25	1.80	6.60
13	2.00	4.00	6.00	6.75	7.75	8.67	5.67	2.67	1.58	1.25	1.80	6.90
14	2.00	4.00	6.00	6.92	7.75	8.67	5.50	2.58	1.58	1.25	1.80	7.20
15	2.00	4.00	6.00	6.92	7.75	8.58	5.25	2.58	1.58	1.25	2.10	7.50
16	2.00	4.00	6.00	7.33	7.75	8.58	5.00	2.50	1.58	1.25	3.10	7.60
17	2.00	4.17	5.83	7.50	7.75	8.58	4.75	2.42	1.58	1.25	4.35	7.60
18	2.00	4.17	5.83	7.58	7.67	8.58	4.58	2.42	1.58	1.25	5.30	7.50
19	3.17	4.17	5.67	7.58	7.67	8.58	4.42	2.33	1.58	1.25	6.00	7.40
20	3.17	4.33	5.67	7.58	7.58	8.58	4.25	2.33	1.58	1.25	6.30	7.20
21	3.33	4.33	5.67	7.50	7.50	8.50	4.17	2.25	1.58	1.25	6.30	7.10
22	3.42	4.33	5.83	7.33	7.50	8.50	4.00	2.17	1.58	1.17	6.35	7.00
23	3.50	4.33	6.00	7.17	7.50	8.50	4.00	2.17	1.50	1.17	6.35	6.70
24	3.50	4.33	6.33	7.08	7.50	8.50	3.83	2.08	1.50	1.17	6.20	6.60
25	3.67	4.42	7.00	7.00	7.58	8.50	3.67	2.08	1.50	1.45	6.20	6.60
26	3.67	4.42	7.00	7.00	7.58	8.42	3.50	2.08	1.50	1.45	6.00	6.20
27	4.00	4.42	7.33	7.08	7.67	8.33	3.42	2.08	1.50	1.45	5.60	6.10
28	4.00	4.83	7.50	7.17	7.75	8.33	3.42	2.08	1.50	1.40	5.50	6.00
29	4.00	6.33	7.50	7.17	7.83	8.25	3.42	2.00	1.42	1.40	5.20	5.80
30	4.00	.....	7.67	7.25	8.00	8.17	3.33	1.92	1.42	1.40	5.00	5.60
31	4.00	.....	7.67	.....	8.17	.....	3.33	1.92	.....	1.40	.....	5.50

* NOTE.—See description for statement regarding these corrected gage heights.

Daily gage height (Martha Street gage), in feet, of Spokane River at Spokane, Wash., for 1909.

[A. C. Lingle, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	17.60	21.29	19.24	21.25	22.73	25.14	21.20	17.95	17.91	17.44	17.38	23.60
2	17.66	21.05	20.20	21.32	22.68	25.10	20.35	17.89	17.85	17.44	17.57	23.70
3	17.40	20.62	19.65	21.60	22.70	25.30	20.00	17.84	17.82	17.36	17.48	23.80
4	17.43	20.25	19.65	21.70	22.68	25.50	19.85	17.88	17.79	17.26	17.40	24.10
5	17.37	19.65	19.65	21.78	22.86	25.68	19.20	17.86	17.80	17.45	17.90	24.10
6	17.28	19.40	19.80	21.81	23.20	25.77	18.90	17.84	17.77	17.38	18.50	24.02
7	17.35	19.30	19.70	21.75	23.50	25.80	19.70	17.82	17.76	17.44	19.20	23.93
8	17.35	19.22	19.78	21.60	23.60	25.76	20.90	17.80	17.72	17.42	19.27	23.93
9	17.45	19.22	19.89	21.48	23.60	25.68	19.25	17.81	17.68	17.42	19.35	23.85
10	17.50	19.20	19.94	21.46	23.60	25.50	19.18	17.85	17.58	17.38	19.40	23.66
11	17.45	19.12	20.05	21.45	23.54	25.34	20.20	17.90	17.61	17.27	19.45	23.48
12	17.25	19.08	19.98	21.48	23.55	25.15	19.85	17.85	17.64	17.40	19.00	23.25
13	17.15	18.70	20.05	21.50	23.50	24.89	19.55	17.80	17.69	17.48	18.15	23.08
14	17.30	18.75	19.95	21.48	23.43	24.60	19.08	17.86	17.57	17.45	18.10	22.93
15	17.44	18.30	19.90	21.54	23.37	24.24	18.45	17.94	17.56	17.50	18.00	22.80
16	17.71	18.19	19.80	21.65	23.33	23.68	18.28	17.86	17.55	17.45	18.12	22.57
17	17.40	18.27	19.83	21.68	23.47	22.42	18.18	17.85	17.45	17.50	18.10	22.35
18	17.61	18.75	19.89	21.68	23.55	22.45	18.20	17.87	17.55	17.32	18.10	22.60
19	17.58	19.50	20.10	21.71	23.62	22.90	18.14	17.86	17.48	17.37	18.80	22.35
20	17.64	18.42	20.13	21.68	23.67	22.80	18.09	17.87	17.40	17.43	19.60	22.10
21	17.50	18.47	20.15	21.72	23.70	22.60	18.05	17.90	17.75	17.46	20.20	21.80
22	20.95	20.45	20.12	21.78	23.80	22.40	18.06	17.93	17.72	17.52	21.00	21.50
23	21.52	20.42	20.10	21.82	23.90	21.80	18.08	17.82	17.61	17.60	21.15	21.20
24	22.15	20.37	20.00	21.40	23.92	21.75	18.08	17.90	17.57	17.67	21.25	20.98
25	22.35	20.30	20.10	21.95	23.96	21.62	18.11	17.95	17.55	17.35	21.50	20.73
26	22.35	20.26	20.25	22.00	24.00	21.55	18.09	17.90	17.45	17.55	21.95	20.61
27	22.20	19.94	20.32	22.10	24.20	21.50	18.08	17.91	17.30	17.52	22.65	20.53
28	22.10	19.30	20.48	22.30	24.50	21.49	17.95	17.90	17.35	17.55	25.02	20.26
29	21.90	.....	20.80	22.52	24.70	21.47	17.91	17.92	17.38	17.50	23.30	20.27
30	21.65	.....	20.95	22.70	24.97	21.42	17.87	17.85	17.43	17.58	23.40	20.10
31	21.45	.....	21.10	.....	25.10	.....	17.90	17.90	.....	17.65	.....	19.63

NOTE.—Ice 1½ inches thick extended 10 to 12 feet out from shore January 9 to 14, 1909.

Table of relation between gage heights of the Washington Water Power Co.'s gage at the dam, and the United States Geological Survey gage at the Oregon Railroad & Navigation Co.'s bridge.

Washington Water Power Co.'s gage.	United States Geological Survey gage.	Washington Water Power Co.'s gage.	United States Geological Survey gage.
Feet.	*Feet.*	*Feet.*	*Feet.*
1.0	1.05	6.0	5.85
1.5	1.45	7.0	6.90
2.0	1.90	8.0	7.95
2.5	2.375	9.0	9.00
3.0	2.85	10.0	10.25
4.0	3.85	11.0	11.80
5.0	4.85	12.0	13.55

NOTE.—See description for statement regarding this table.

Rating table for Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., from March 22, 1891, to October 24, 1896.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.00	1,350	2.30	3,380	3.60	6,030	5.80	11,820
1.10	1,480	2.40	3,560	3.70	6,250	6.00	12,400
1.20	1,620	2.50	3,750	3.80	6,480	6.20	12,980
1.30	1,760	2.60	3,940	3.90	6,720	6.40	13,580
1.40	1,900	2.70	4,140	4.00	6,960	6.60	14,200
1.50	2,050	2.80	4,340	4.20	7,460	6.80	14,840
1.60	2,200	2.90	4,540	4.40	7,980	7.00	15,480
1.70	2,360	3.00	4,750	4.60	8,500	8.00	18,800
1.80	2,520	3.10	4,960	4.80	9,020	9.00	22,300
1.90	2,680	3.20	5,170	5.00	9,560	10.00	26,000
2.00	2,850	3.30	5,380	5.20	10,120	11.00	29,800
2.10	3,020	3.40	5,590	5.40	10,680	12.00	33,600
2.20	3,200	3.50	5,810	5.60	11,240	13.00	37,500

NOTE.—This table was obtained from the gage-relation table published above and the rating table used for 1897 (see Nineteenth Ann. Rept. U. S. Geol. Survey, pt. 4, 1897, p. 488). It is applicable to the corrected gage heights published in this report.

Rating table for Spokane River at Spokane, Wash., for October 25 to December 31, 1896.

Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1.40	1,897	2.70	4,141	4.00	7,000	5.60	11,243
1.50	2,046	2.80	4,340	4.10	7,243	5.80	11,824
1.60	2,199	2.90	4,543	4.20	7,489	6.00	12,416
1.70	2,356	3.00	4,749	4.30	7,738	6.20	13,019
1.80	2,517	3.10	4,959	4.40	7,990	6.40	13,631
1.90	2,682	3.20	5,172	4.50	8,245	6.60	14,253
2.00	2,851	3.30	5,389	4.60	8,503	6.80	14,885
2.10	3,024	3.40	5,609	4.70	8,764	7.00	15,525
2.20	3,201	3.50	5,832	4.80	9,028	7.20	16,173
2.30	3,382	3.60	6,059	4.90	9,295	7.40	16,829
2.40	3,566	3.70	6,289	5.00	9,565	7.60	17,493
2.50	3,754	3.80	6,523	5.20	10,114	7.80	18,165
2.60	3,946	3.90	6,760	5.40	10,673		

NOTE.—The above table is not applicable for ice or obstructed channel conditions. It is based on discharge measurements made during 1896 to 1900 and is well defined. This is the same curve as used for 1897 and 1898 and published in Nineteenth Annual Report of the United States Geological Survey, pt. 4, 1897, p. 488.

Daily discharge, in second-feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891 to 1896 and 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1891.												
1	.....	.....	.....	2,990	12,400	9,370	4,140	2,100	1,720	1,660	1,690	3,430
2	.....	.....	.....	2,990	12,400	8,940	4,300	1,980	1,720	1,660	1,800	3,750
3	.....	.....	.....	3,150	12,200	8,500	4,300	1,980	1,720	1,650	2,050	3,750
4	.....	.....	.....	3,150	11,400	8,060	4,140	1,980	1,710	1,650	2,310	3,750
5	.....	.....	.....	3,150	11,000	7,640	4,140	2,000	1,710	1,650	2,570	3,900
6	.....	.....	.....	3,150	11,000	7,640	4,140	2,000	1,710	1,650	2,570	3,900
7	.....	.....	.....	3,150	11,400	7,210	3,810	2,000	1,710	1,650	2,710	3,900
8	.....	.....	.....	3,750	11,900	7,210	3,810	1,870	1,710	1,640	2,710	3,900
9	.....	.....	.....	4,240	12,400	7,010	3,660	1,870	1,700	1,640	2,850	3,900
10	.....	.....	.....	4,580	12,400	6,790	3,660	1,870	1,700	1,640	2,850	3,900
11	.....	.....	.....	4,580	13,100	6,600	3,660	1,870	1,700	1,640	2,850	3,900
12	.....	.....	.....	4,580	12,400	6,410	3,660	1,760	1,700	1,630	2,850	3,750
13	.....	.....	.....	5,110	12,400	6,030	3,510	1,760	1,700	1,630	2,990	3,750
14	.....	.....	.....	5,440	12,400	6,030	3,510	1,760	1,690	1,630	2,990	3,750
15	.....	.....	.....	5,810	12,400	6,030	3,510	1,760	1,690	1,630	3,150	3,750

NOTE.—Discharges Aug. 14 to Oct. 18, 1891, interpolated.

Daily discharge, in second-feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891 to 1896 and 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1891.												
16	.....	.....	.....	6,360	12,900	5,850	3,510	1,750	1,690	1,630	3,150	3,750
17	.....	.....	.....	6,770	12,900	5,660	3,340	1,750	1,690	1,629	3,150	3,750
18	.....	.....	.....	7,160	13,100	5,480	3,200	1,750	1,680	1,620	3,290	3,900
19	.....	.....	.....	8,240	13,100	5,320	3,200	1,750	1,680	1,620	3,290	3,900
20	.....	.....	.....	9,340	12,900	5,130	3,200	1,750	1,680	1,580	3,290	3,900
21	.....	.....	.....	11,000	12,600	4,960	3,060	1,740	1,680	1,580	3,430	3,900
22	.....	.....	.....	11,200	12,400	4,960	2,900	1,740	1,680	1,580	3,430	3,900
23	.....	.....	.....	11,400	11,900	4,790	2,900	1,740	1,670	1,580	3,430	3,900
24	.....	.....	.....	11,900	11,900	4,790	2,760	1,740	1,670	1,580	3,430	3,900
25	.....	.....	.....	11,900	11,000	4,600	2,630	1,730	1,670	1,580	3,430	3,900
26	.....	.....	.....	11,900	10,700	4,440	2,630	1,730	1,670	1,580	3,430	3,900
27	.....	.....	.....	11,900	10,300	4,280	2,630	1,730	1,670	1,580	3,430	3,900
28	.....	.....	.....	11,900	9,560	4,280	2,360	1,730	1,660	1,580	3,430	3,900
29	.....	.....	.....	11,900	9,560	4,280	2,230	1,730	1,660	1,580	3,430	3,900
30	.....	.....	.....	12,400	9,560	4,280	2,230	1,720	1,660	1,580	3,430	3,900
31	.....	.....	.....	.....	9,100	.....	2,100	1,720	.....	1,690	.....	3,900
1892.												
1	3,900	3,430	4,920	11,200	11,000	22,300	10,500	3,900	2,340	1,350	1,350	2,850
2	3,600	3,150	5,110	10,700	11,000	22,300	10,300	3,900	2,290	1,350	1,350	2,850
3	3,600	3,150	5,280	10,500	11,000	22,300	10,090	3,850	2,230	1,350	1,350	2,990
4	3,600	3,150	5,440	9,780	11,000	22,000	9,780	3,800	2,180	1,350	1,350	2,990
5	3,600	3,150	5,630	9,340	11,000	21,700	9,560	3,740	2,130	1,350	1,350	3,150
6	3,600	3,150	5,810	9,100	11,200	21,100	9,340	3,690	2,080	1,350	1,350	3,150
7	3,600	3,150	5,810	8,890	11,400	20,800	9,100	3,640	2,030	1,350	1,350	3,290
8	3,600	3,150	5,810	8,890	11,700	20,200	8,890	3,590	1,970	1,350	1,350	3,290
9	3,600	3,150	5,990	8,890	11,900	19,600	8,680	3,540	1,920	1,350	1,350	3,290
10	3,600	3,150	6,180	8,890	12,200	18,800	8,450	3,480	1,870	1,350	1,350	3,290
11	3,290	3,150	6,550	8,890	12,600	18,000	8,240	3,430	1,820	1,350	1,350	3,290
12	3,290	3,290	6,960	8,890	13,400	17,600	7,800	3,380	1,770	1,350	1,350	3,290
13	3,290	3,290	7,800	8,890	14,100	17,400	7,590	3,330	1,710	1,350	1,350	3,290
14	3,290	3,290	8,680	9,100	14,700	17,100	7,380	3,280	1,660	1,350	1,350	3,290
15	3,290	3,290	9,340	9,340	15,200	16,600	7,160	3,220	1,610	1,350	1,350	3,150
16	3,290	3,290	10,000	9,560	15,500	16,300	6,960	3,170	1,560	1,350	1,450	3,150
17	3,290	3,290	10,500	9,780	15,700	15,700	6,770	3,120	1,510	1,350	1,580	3,150
18	3,290	3,290	11,000	10,000	16,000	15,500	6,550	3,070	1,450	1,350	1,580	2,990
19	3,290	3,290	11,400	10,300	16,300	14,900	6,360	3,020	1,400	1,350	1,690	2,990
20	3,290	3,290	11,700	10,300	16,600	14,400	6,180	2,960	1,350	1,350	1,690	2,850
21	3,290	3,290	11,700	10,300	16,900	14,200	5,990	2,910	1,350	1,350	1,800	2,710
22	3,290	3,290	11,700	10,300	17,400	13,400	5,810	2,860	1,350	1,350	1,800	2,710
23	3,290	3,430	11,400	10,300	18,200	13,100	5,440	2,810	1,350	1,350	1,930	2,570
24	2,990	3,750	11,700	10,300	18,800	12,600	5,320	2,750	1,350	1,350	2,050	2,570
25	2,990	4,240	11,900	10,300	19,900	12,400	4,750	2,700	1,350	1,350	2,170	2,570
26	2,990	4,580	11,900	10,500	21,100	11,900	4,400	2,650	1,350	1,350	2,310	2,710
27	2,990	4,750	11,900	10,500	21,400	11,700	4,240	2,600	1,350	1,350	2,440	2,710
28	2,990	4,750	11,900	10,500	22,000	11,400	4,080	2,550	1,350	1,350	2,570	2,710
29	2,990	4,750	11,900	10,500	22,300	11,200	3,900	2,490	1,350	1,350	2,710	2,850
30	2,990	.....	11,900	10,700	22,300	11,000	3,900	2,440	1,350	1,350	2,710	2,850
31	2,990	.....	11,700	.....	22,300	.....	3,900	2,390	.....	1,350	.....	2,990
1893.												
1	2,990	2,710	2,170	5,810	16,700	23,900	13,700	4,810	2,100	1,690	4,750	4,580
2	3,150	2,570	2,170	6,360	17,200	23,900	13,500	4,640	2,100	1,800	4,750	4,580
3	3,150	2,570	2,170	7,160	17,800	23,900	13,000	4,640	1,980	1,930	4,580	4,400
4	3,290	2,570	2,170	7,800	18,400	23,900	13,000	4,480	1,980	2,050	4,400	4,400
5	3,430	2,440	2,170	8,680	18,600	23,900	12,700	4,480	1,980	2,170	4,400	4,400
6	3,600	2,440	2,170	10,100	18,900	23,000	12,500	4,480	1,860	2,310	4,580	4,400
7	3,750	2,440	2,170	11,300	19,200	23,000	12,300	4,300	1,730	2,570	5,110	4,400
8	3,750	2,440	2,310	12,200	19,500	23,000	12,000	4,300	1,730	2,850	6,180	4,400
9	3,900	2,310	2,310	12,500	20,100	23,000	11,800	4,140	1,620	3,290	7,380	5,110
10	3,900	2,310	2,310	13,200	20,600	23,000	11,300	4,140	1,620	3,750	8,240	6,180
11	3,900	2,170	2,310	13,200	21,200	22,700	10,800	4,140	1,620	4,240	8,680	6,960
12	3,900	2,170	2,310	13,200	22,100	22,400	10,100	3,980	1,690	4,750	8,890	9,100
13	3,900	2,170	[a] 2,310	12,700	22,100	22,100	9,900	3,980	1,690	4,750	9,100	9,560
14	3,750	2,170	[a] 2,310	12,700	23,000	21,500	9,420	3,810	1,580	4,750	9,100	9,560
15	3,750	2,170	2,310	12,300	23,900	20,900	8,970	3,660	1,580	4,750	9,100	9,340

[a] Interpolated.

NOTE.—Discharges Aug. 3 to Sept. 19, 1892, interpolated.

Daily discharge, in second-feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891 to 1896 and 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1893.												
16	3,750	2,170	2,310	12,000	25,800	20,300	8,550	3,510	1,580	4,920	8,890	9,100
17	3,600	2,170	2,310	11,500	26,800	19,500	8,110	3,340	1,580	4,920	8,680	8,680
18	3,600	2,170	2,310	11,300	27,700	19,200	7,670	3,200	1,580	4,920	8,240	8,240
19	3,430	2,170	2,310	11,000	30,600	18,600	7,460	3,060	1,580	4,920	7,800	7,800
20	3,290	2,170	2,310	10,800	31,500	18,100	7,260	2,900	1,580	5,110	7,160	7,380
21	3,290	2,170	2,310	10,800	31,500	17,500	7,040	2,900	1,450	5,110	6,550	7,380
22	3,150	2,170	2,440	11,000	31,200	17,200	6,650	2,760	1,450	5,110	5,990	7,380
23	3,150	2,170	2,440	11,300	29,600	16,700	6,250	2,760	1,450	5,110	5,630	7,160
24	3,150	2,170	2,570	12,000	28,700	16,100	6,070	2,630	1,450	5,110	5,280	6,960
25	2,990	2,170	2,570	13,000	28,700	16,100	5,880	2,490	1,450	5,110	5,110	6,960
26	2,990	2,170	2,850	14,300	27,400	15,600	5,530	2,360	1,450	5,110	4,750	6,770
27	2,850	2,170	3,150	14,800	26,800	15,600	5,170	2,230	1,450	5,110	4,750	6,770
28	2,850	2,170	3,600	15,300	25,800	15,100	5,170	2,230	1,450	5,110	4,750	6,770
29	2,710	.....	4,080	15,900	24,900	14,500	5,170	2,230	1,450	5,110	4,750	6,550
30	2,710	.....	4,580	16,100	24,900	14,000	5,170	2,100	1,450	4,920	4,750	6,550
31	2,710	.....	5,280	.....	24,900	.....	5,000	2,100	.....	4,920	.....	6,550
1894.												
1	6,360	6,180	2,440	8,240	26,300	34,900	16,600	7,010	3,020	2,600	3,600	5,810
2	6,360	5,810	2,440	9,100	26,000	34,900	16,400	6,790	2,880	2,600	3,750	5,990
3	6,180	5,440	2,710	9,560	25,400	34,900	15,800	6,600	2,880	2,600	3,900	5,990
4	5,990	5,110	2,710	11,700	25,100	34,600	15,200	6,600	2,880	2,600	4,080	5,990
5	5,810	4,750	2,710	11,900	24,400	34,600	14,800	6,410	2,880	2,600	4,080	5,990
6	5,630	4,750	2,710	11,900	24,100	34,600	14,200	6,210	2,880	2,600	4,240	5,990
7	5,440	4,580	2,710	11,900	24,100	33,900	14,000	6,210	2,730	2,600	4,240	5,810
8	5,280	4,580	2,850	11,900	23,800	33,300	13,400	6,030	2,730	2,600	4,400	5,810
9	5,110	4,400	2,850	11,900	23,800	32,300	12,900	5,850	2,730	2,600	4,580	5,810
10	4,750	4,400	2,850	12,400	23,800	31,100	12,500	5,660	2,730	2,570	4,750	5,810
11	4,400	4,240	2,850	12,400	23,500	26,000	12,200	5,480	2,730	2,570	5,110	5,810
12	4,080	4,080	2,850	13,100	23,200	27,600	12,000	5,320	2,730	2,570	5,280	5,810
13	4,080	3,750	2,850	14,100	23,200	27,000	11,700	5,130	2,600	2,570	5,280	5,440
14	4,240	3,750	2,990	15,200	22,900	26,100	11,500	4,960	2,600	2,440	5,280	5,440
15	5,110	3,750	2,990	16,300	22,600	25,100	11,000	4,790	2,600	2,440	5,280	5,280
16	7,590	3,430	2,990	17,400	22,600	24,500	10,800	4,600	2,600	2,440	5,280	5,110
17	9,560	3,430	2,990	17,700	23,500	23,900	10,300	4,440	2,600	2,440	5,280	4,920
18	11,000	3,150	3,150	17,700	24,400	23,600	9,840	4,280	2,600	2,440	5,280	4,920
19	11,200	2,850	3,150	17,400	25,700	23,300	9,370	4,100	2,600	2,310	5,110	4,750
20	11,200	2,710	3,430	17,100	26,300	22,700	9,160	3,940	2,600	2,310	4,920	4,750
21	11,000	2,570	3,600	16,900	26,600	22,000	8,710	3,790	2,600	2,310	4,750	4,580
22	10,500	2,570	3,900	16,900	27,300	21,800	8,290	3,620	2,600	2,310	4,750	4,580
23	9,560	2,570	4,080	16,900	27,900	21,200	8,060	3,470	2,600	2,310	4,750	4,400
24	9,100	2,440	4,080	17,400	28,800	20,600	7,850	3,470	2,600	2,310	4,750	4,400
25	8,680	2,440	4,080	19,100	29,800	20,000	7,850	3,330	2,600	2,310	4,920	4,240
26	8,030	2,440	4,240	20,200	31,100	19,400	7,640	3,160	2,600	2,570	4,920	4,240
27	7,590	2,440	4,580	20,800	32,300	18,900	7,640	3,160	2,600	2,850	4,920	4,240
28	7,160	2,440	4,920	22,000	33,600	18,300	7,410	3,160	2,600	3,150	5,110	4,080
29	6,960	.....	5,440	22,600	34,300	17,700	7,410	3,160	2,600	3,290	5,280	3,900
30	6,550	.....	6,180	22,600	34,300	17,200	7,210	3,020	2,600	3,430	5,630	3,750
31	[a] 6,360	.....	6,960	.....	35,200	.....	7,210	3,020	.....	3,430	.....	3,750
1895.												
1	3,600	5,810	9,100	7,380	15,500	12,400	5,440	2,440	1,690	1,350	1,350	2,050
2	3,600	5,630	9,100	7,800	16,000	12,400	5,280	2,440	1,690	1,350	1,350	2,050
3	3,430	5,630	9,340	8,030	16,000	11,900	4,750	2,440	1,690	1,350	1,350	2,050
4	3,430	5,280	9,560	8,240	16,300	11,700	4,750	2,440	1,690	1,350	1,350	2,050
5	3,290	5,110	9,780	8,680	16,300	11,400	4,750	2,310	1,630	1,350	1,350	2,050
6	3,290	5,110	9,780	8,680	16,600	11,200	4,750	2,310	1,580	1,350	1,450	2,050
7	3,290	4,920	9,560	8,890	17,100	11,200	4,400	2,170	1,520	1,350	1,450	2,050
8	3,290	4,750	9,100	8,890	17,100	11,000	4,400	2,170	1,400	1,350	1,580	2,050
9	3,290	4,580	9,100	8,890	17,400	10,500	4,240	2,170	1,410	1,350	1,580	2,050
10	3,430	4,400	8,890	9,100	17,700	9,560	4,080	2,170	1,350	1,350	1,580	2,050
11	3,430	4,400	8,680	9,340	17,700	9,560	4,080	2,170	1,350	1,350	1,580	2,170
12	3,600	4,240	8,240	9,560	17,100	9,560	3,900	2,050	1,450	1,350	1,580	2,170
13	4,080	4,240	8,240	9,560	16,600	9,560	3,900	2,050	1,580	1,350	1,580	2,310
14	4,920	4,080	8,030	10,000	15,500	9,560	3,750	1,930	1,350	1,350	1,580	2,310
15	5,810	3,900	8,030	10,300	15,500	8,680	3,750	1,930	1,350	1,350	1,580	2,310

[a] Interpolated.

Daily discharge, in second-feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891 to 1896 and 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1895.												
16	6,960	3,900	8,030	10,500	14,900	8,240	3,600	1,930	1,350	1,350	1,580	2,310
17	7,800	3,900	7,590	11,000	14,700	7,800	3,600	1,930	1,350	1,350	1,580	2,310
18	7,800	3,900	7,380	11,400	14,700	7,590	3,600	1,890	1,350	1,350	1,580	2,310
19	7,800	3,750	7,380	11,400	14,400	7,380	3,430	1,850	1,350	1,350	1,580	2,310
20	7,800	3,750	6,960	11,700	14,100	7,160	3,430	1,810	1,350	1,350	1,580	2,310
21	8,030	3,750	6,960	11,700	14,100	6,960	3,290	1,770	1,350	1,350	1,580	2,310
22	7,590	3,750	6,770	11,700	14,100	6,550	3,290	1,730	1,350	1,350	1,580	2,310
23	7,590	4,080	6,550	11,900	14,100	6,550	3,150	1,690	1,350	1,350	1,580	2,310
24	7,380	5,110	6,360	11,900	13,900	6,180	2,990	1,690	1,350	1,350	1,580	2,310
25	7,380	5,990	6,360	12,400	13,400	5,990	2,850	1,690	1,350	1,350	1,580	2,310
26	7,160	6,960	6,360	12,900	13,400	5,810	2,850	1,690	1,350	1,350	1,580	2,310
27	6,960	7,800	6,360	13,900	12,900	5,810	2,850	1,690	1,350	1,350	1,690	2,310
28	6,550	8,680	6,180	14,400	12,400	5,810	2,850	1,690	1,350	1,350	1,800	2,310
29	6,180	.....	6,180	15,200	12,400	5,810	2,710	1,690	1,350	1,350	1,800	2,440
30	6,180	.....	6,180	15,500	12,400	5,810	2,570	1,690	1,350	1,350	1,800	2,440
31	5,990	.....	6,960	.....	12,400	.....	2,440	1,690	.....	1,350	.....	2,440
1896.												
1	2,440	6,960	13,400	17,700	16,600	20,200	18,800	5,280	2,570	1,930	1,900	8,760
2	2,440	6,960	12,900	17,100	16,900	21,100	18,200	5,280	2,570	1,930	2,050	8,500
3	2,440	6,960	12,900	17,100	16,900	21,100	17,700	5,110	2,570	1,800	2,050	8,500
4	2,440	6,960	12,400	17,100	17,100	21,400	17,100	4,920	2,440	1,800	2,050	8,760
5	2,570	6,960	12,400	16,600	17,100	21,400	16,600	4,750	2,440	1,800	2,120	10,100
6	2,570	6,960	12,400	16,000	17,400	21,700	15,700	4,750	2,440	1,800	2,120	11,000
7	2,570	6,960	12,400	14,900	17,400	22,000	14,900	4,580	2,310	1,800	2,200	11,200
8	2,570	6,960	12,400	14,900	17,700	21,700	14,100	4,400	2,310	1,800	2,200	12,000
9	2,710	6,960	12,400	14,400	17,700	21,400	13,400	4,400	2,310	1,690	2,280	12,700
10	2,710	6,960	12,400	14,400	18,000	21,400	12,900	4,240	2,310	1,690	2,280	13,300
11	2,710	6,960	12,400	14,400	18,000	21,400	12,400	4,240	2,310	1,690	2,360	13,900
12	2,710	6,960	12,400	14,400	18,000	21,400	11,900	4,080	2,170	1,690	2,520	14,300
13	2,850	6,960	12,400	14,700	18,000	21,100	11,400	4,080	2,170	1,690	2,520	15,200
14	2,850	6,960	12,400	15,200	18,000	21,100	11,000	3,900	2,170	1,690	2,520	16,200
15	2,850	6,960	12,400	15,200	18,000	20,800	10,300	3,900	2,170	1,690	3,020	17,200
16	2,850	6,960	12,400	16,600	18,000	20,800	9,560	3,750	2,170	1,690	4,960	17,500
17	2,850	7,380	11,900	17,100	18,000	20,800	8,890	3,600	2,170	1,690	7,800	17,500
18	2,850	7,380	11,900	17,400	17,700	20,800	8,450	3,600	2,170	1,690	10,400	17,200
19	5,110	7,380	11,400	17,400	17,700	20,800	8,030	3,430	2,170	1,690	12,400	16,800
20	5,110	7,800	11,400	17,400	17,400	20,800	7,590	3,430	2,170	1,690	13,300	16,200
21	5,440	7,800	11,400	17,100	17,100	20,500	7,380	3,290	2,170	1,690	13,300	15,800
22	5,630	7,800	11,900	16,600	17,100	20,500	6,960	3,150	2,170	1,580	13,500	15,500
23	5,810	7,800	12,400	16,000	17,100	20,500	6,960	3,150	2,050	1,580	13,500	14,600
24	5,810	7,800	13,400	15,700	17,100	20,500	6,550	2,990	2,050	1,580	13,000	14,300
25	6,180	8,030	15,500	15,500	17,400	20,500	6,180	2,990	2,050	1,970	13,000	14,300
26	6,180	8,030	15,500	15,500	17,400	20,200	5,810	2,990	2,050	1,970	12,400	13,000
27	6,960	8,030	16,600	15,700	17,700	19,900	5,630	2,990	2,050	1,970	11,200	12,700
28	6,960	9,100	17,100	16,000	18,000	19,900	5,630	2,990	2,050	1,900	11,000	12,400
29	6,960	13,400	17,100	16,000	18,200	19,600	5,630	2,850	1,930	1,900	10,100	11,800
30	6,960	.....	17,700	16,300	18,800	19,400	5,440	2,710	1,930	1,900	9,560	11,200
31	6,960	.....	17,700	.....	19,400	.....	5,440	2,710	.....	1,900	.....	11,000

(Martha Street gage.)

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	2,200	8,180	4,580	8,100	11,200	17,400	8,000	2,640	2,580	2,010	1,940	13,300
2	2,270	7,700	6,160	8,240	11,100	17,300	6,430	2,560	2,500	2,010	2,160	13,500
3	1,960	6,920	5,240	8,800	11,100	17,900	5,800	2,490	2,470	1,910	2,060	13,800
4	2,000	6,250	5,240	9,000	11,100	18,500	5,560	2,540	2,430	1,800	1,960	14,000
5	1,920	5,240	5,240	9,160	11,500	19,000	4,520	2,520	2,440	2,020	2,570	14,600
6	1,820	4,840	5,480	9,220	12,300	19,300	4,040	2,490	2,400	1,940	3,420	14,400
7	1,900	4,680	5,320	9,100	13,000	19,400	5,320	2,470	2,390	2,010	4,520	14,100
3	1,900	4,550	5,450	8,800	13,300	19,300	7,420	2,440	2,340	1,980	4,630	14,100
9	2,020	4,550	5,620	8,500	13,300	19,000	4,600	2,450	2,300	1,980	4,760	13,900
10	2,080	4,520	5,700	8,520	13,300	18,500	4,490	2,500	2,180	1,940	4,840	13,400
11	2,020	4,390	5,890	8,500	13,100	18,000	6,160	2,570	2,210	1,810	4,920	13,000
12	1,780	4,330	5,770	8,500	13,100	17,400	5,560	2,500	2,250	1,960	4,200	12,400
13	1,680	3,720	5,890	8,600	13,000	16,700	5,080	2,440	2,310	2,060	2,910	12,000
14	1,840	3,800	5,720	8,500	12,800	15,900	4,330	2,520	2,100	2,020	2,840	11,000
15	2,010	3,120	5,640	8,680	12,700	14,900	3,340	2,620	2,150	2,080	2,700	11,300

NOTE.—Discharges interpolated Aug. 18 to 22, Sept. 5 to 9, and Oct. 25 to 30, 1895.

Daily discharge, in second-feet, of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891 to 1896 and 1909.—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2,330	2,970	5,480	8,900	12,600	13,500	3,090	2,520	2,140	2,020	2,870	10,800
17	1,960	3,080	5,530	8,960	12,900	10,500	2,950	2,500	2,020	2,080	2,840	10,300
18	2,210	3,800	5,620	8,960	13,100	10,600	2,980	2,530	2,140	1,860	2,840	10,900
19	2,180	5,000	5,980	9,020	13,300	11,600	2,900	2,520	2,060	1,920	3,880	10,300
20	2,250	3,300	6,030	8,960	13,400	11,300	2,830	2,530	1,960	2,000	5,160	9,800
21	2,080	3,380	6,070	9,040	13,500	10,900	2,770	2,570	2,380	2,030	6,160	9,200
22	7,510	6,610	6,020	9,160	13,800	10,400	2,780	2,610	2,340	2,100	7,600	8,600
23	8,640	6,560	5,980	9,240	14,000	9,200	2,810	2,470	2,210	2,200	7,900	8,000
24	9,900	6,470	5,800	9,400	14,100	9,100	2,810	2,570	2,160	2,280	8,100	7,560
25	10,300	6,340	5,980	9,500	14,200	8,840	2,850	2,640	2,140	1,900	8,600	7,110
26	10,300	6,270	6,250	9,600	14,300	8,700	2,830	2,570	2,020	2,140	9,500	6,900
27	10,000	5,700	6,380	9,800	14,800	8,600	2,810	2,580	1,840	2,100	11,000	6,750
28	9,800	4,680	6,660	10,200	15,000	8,580	2,640	2,570	1,900	2,140	17,100	6,270
29	9,400	.....	7,240	10,700	16,200	8,540	2,580	2,600	1,940	2,080	12,500	6,290
30	8,900	.....	7,510	11,100	16,900	8,440	2,530	2,500	2,000	2,180	12,800	5,980
31	8,500	.....	7,800	.....	17,300	.....	2,570	2,570	.....	2,260	.....	5,210

NOTE.—The daily discharges for 1909 are based on a rating curve that is well defined below 2,700 second-feet, and fairly well defined above this. The rating curve was applied as for open-water conditions for the entire year, as the slight ice conditions in January probably caused no appreciable effect on the flow. Discharge under artificial control from Post Falls dam during summer months.

Monthly discharge of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891–1896 and 1909.

[Drainage area, 4,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1891.							
April	12,400	2,990	7,170	1.79	2.00	427,000	.....
May	13,100	9,100	11,800	2.95	3.40	726,000	.....
June	9,370	4,280	6,090	1.52	1.70	362,000	.....
July	4,300	2,100	3,320	.830	.96	204,000	.....
August	2,100	[a] 1,720	1,820	.455	.52	112,000	.....
September	[a] 1,720	[a] 1,660	1,690	.422	.47	101,000	.....
October	1,690	[a] 1,580	1,620	.405	.47	99,600	.....
November	3,430	1,690	2,980	.745	.83	177,000	.....
December	3,900	3,430	3,840	.960	1.11	236,000	.....
The period	.....	.....	.....	.....	.....	2,440,000	.....
1892.							
January	3,900	2,990	3,320	0.830	0.96	204,000	.....
February	4,750	3,150	3,500	.875	.94	201,000	.....
March	11,900	4,920	9,020	2.26	2.61	555,000	.....
April	11,200	8,890	9,850	2.46	2.74	586,000	.....
May	22,300	11,000	15,700	3.92	4.52	965,000	.....
June	22,300	11,000	16,600	4.15	4.63	988,000	.....
July	10,500	3,900	7,010	1.75	2.02	431,000	.....
August	3,900	[a] 2,390	3,170	.792	.91	195,000	.....
September	[a] 2,340	1,350	1,680	.420	.47	100,000	.....
October	1,350	1,350	1,350	.338	.39	83,000	.....
November	2,710	1,350	1,690	.422	.47	101,000	.....
December	3,290	2,570	2,980	.745	.86	183,000	.....
The year	22,300	1,350	6,320	1.58	21.52	4,590,000	.....

[a] Interpolated.

Monthly discharge of Spokane River at Washington Water Power Co.'s dam at Spokane, Wash., for 1891–1896 and 1909—Continued.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1893.							
January	3,900	2,710	3,370	0.842	0.97	207,000	.....
February	2,710	2,170	2,280	.570	.59	127,000	.....
March	5,280	2,170	2,620	.655	.76	161,000	.....
April	16,100	5,810	11,700	2.92	3.26	696,000	.....
May	31,500	16,700	24,100	6.02	6.94	1,480,000	.....
June	23,900	14,000	19,900	4.98	5.56	1,180,000	.....
July	13,700	5,000	8,940	2.24	2.58	550,000	.....
August	4,810	2,100	3,440	.860	.99	212,000	.....
September	2,100	1,450	1,640	.410	.46	97,600	.....
October	5,110	1,690	4,140	1.04	1.20	255,000	.....
November	9,100	4,400	6,410	1.60	1.78	381,000	.....
December	9,560	4,400	6,720	1.68	1.94	413,000	.....
The year	31,500	1,450	7,940	1.98	27.03	5,760,000	.....
1894.							
January	11,200	4,080	7,120	1.78	2.05	438,000	.....
February	6,180	2,440	3,750	.938	.98	208,000	.....
March	6,960	2,440	3,530	.882	1.02	217,000	.....
April	22,600	8,240	15,500	3.88	4.33	922,000	.....
May	35,200	22,600	26,600	6.65	7.67	1,640,000	.....
June	34,900	17,200	26,200	6.55	7.31	1,560,000	.....
July	16,600	7,210	10,900	2.72	3.14	670,000	.....
August	7,010	3,020	4,730	1.18	1.36	291,000	.....
September	3,020	2,600	2,690	.672	.75	160,000	.....
October	3,430	2,310	2,610	.652	.75	160,000	.....
November	5,630	3,600	4,780	1.20	1.34	284,000	.....
December	5,990	3,750	5,080	1.27	1.46	312,000	.....
The year	35,200	2,310	9,460	2.36	32.16	6,860,000	.....
1895.							
January	8,030	3,290	5,510	1.38	1.59	339,000	.....
February	8,680	3,750	4,910	1.23	1.28	273,000	.....
March	9,780	6,180	7,840	1.96	2.26	482,000	.....
April	15,500	7,380	10,700	2.68	2.99	637,000	.....
May	17,700	12,400	15,100	3.78	4.36	928,000	.....
June	12,400	5,810	8,650	2.16	2.41	515,000	.....
July	5,440	2,440	3,730	.932	1.07	229,000	.....
August	2,440	1,690	1,980	.495	.57	122,000	.....
September	1,690	1,350	1,430	.358	.4	85,100	.....
October	1,350	1,350	1,350	.338	.39	83,000	.....
November	1,800	1,350	1,560	.390	.44	92,800	.....
December	2,440	2,050	2,230	.558	.64	137,000	.....
The year	17,700	1,350	5,420	1.36	18.4	3,920,000	.....
1896.							
January	6,960	2,440	4,130	1.03	1.19	254,000	.....
February	13,400	6,960	7,550	1.89	2.04	434,000	.....
March	17,700	11,400	13,300	3.32	3.83	818,000	.....
April	17,700	14,400	16,000	4.0	4.46	952,000	.....
May	19,400	16,600	17,600	4.4	5.07	1,080,000	.....
June	22,000	19,400	20,800	5.2	5.8	1,240,000	.....
July	18,800	5,440	10,500	2.62	3.02	646,000	.....
August	5,280	2,710	3,820	.955	1.1	235,000	.....
September	2,570	1,930	2,220	.555	.62	132,000	.....
October	1,970	1,580	1,770	.442	.51	109,000	.....
November	13,500	1,900	6,790	1.78	1.90	404,000	.....
December	17,500	8,500	13,300	3.32	3.83	818,000	.....
The year	22,000	1,580	9,820	2.45	33.37	7,120,000	.....
1909.							
January	10,300	1,680	4,380	1.10	1.27	269,000	A.
February	8,180	2,970	5,030	1.26	1.31	279,000	A.
March	7,800	4,580	5,910	1.48	1.71	363,000	A.
April	11,100	8,100	9,100	2.28	2.54	541,000	B.
May	17,300	11,100	13,400	3.35	3.86	824,000	B.
June	19,400	8,440	13,900	3.48	3.88	827,000	B.
July	8,000	2,530	4,040	1.01	1.16	248,000	A.
August	2,640	2,440	2,540	.635	.73	156,000	A.
September	2,580	1,840	2,210	.552	.62	132,000	A.
October	2,280	1,800	2,030	.508	.59	125,000	A.
November	17,100	1,940	5,640	1.41	1.57	336,000	B.
December	14,600	5,210	10,600	2.65	3.06	652,000	B.
The year	19,400	1,680	6,560	1.64	22.30	4,750,000	

OKANOGAN RIVER DRAINAGE BASIN.

DESCRIPTION.

Okanogan River rises in Okanogan Lake, in British Columbia, and flows southward, entering Columbia River near Brewster, Wash. Its course in Canada lies through a series of narrow lakes. The drainage area is comparatively rough and mountainous, and is timbered except along the river. The rainfall is approximately 20 inches a year.

The principal tributaries in the United States are Similkameen and Conconully rivers and Sinlahekin, Antoine, Bonaparte, Johnson, and Salmon creeks. The main stream is navigable from Brewster to Riverside, except during low-water periods, and the tributaries are used largely for irrigation.

SALMON CREEK NEAR OKANOGAN, WASH.[1]

This station, which was established May 27, 1903, is located on the stage road between Malott and Conconully, 14 miles from Malott and 11 miles from Conconully, and is 6 miles above Okanogan, Wash., at the mouth of the stream. The waters of this creek are used for storage in the development of the Okanogan project of the United States Reclamation Service, which has recently been completed. (See Pl. IV, *B*.) About 20,000 acres of land have been brought under irrigation and are at present open to settlement under the terms of the reclamation act.

The vertical staff gage is on the left bank, opposite the house of the observer. Discharge measurements are made from a footbridge.

The conditions at the station are favorable for good results. The bed of the creek, however, is not stable, and in order to obtain refined results frequent discharge measurements should be made each year.

Discharge measurements of Salmon Creek near Okanogan, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 17	Howard Kimble	24.7	55.2	1.99	139
18	do	24.7	58.7	2.08	163

[1] Formerly known as "near Malott."

Daily gage heights, in feet, of Salmon Creek near Okanogan, Wash., for 1909.

[Ernest Jones, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.58	0.58	0.67	1.06	0.96	1.83	0.92	1.25	1.17	0.67	0.67	0.92
2	.58	.62	.67	1.00	1.00	2.00	.88	1.25	1.17	.60	.69	.88
3	.56	.62	.69	1.00	1.33	1.67	.81	1.25	1.12	.58	.67	.75
4	.58	.67	.67	.96	1.58	1.67	.81	1.25	1.12	.54	.67	.71
5	.54	.71	.67	.96	1.50	1.75	.69	1.24	1.12	.52	.67	.71
6	.50	.67	.67	.92	1.29	1.75	.71	1.25	1.12	.50	.67	.67
7	.46	.67	.67	.92	1.25	1.83	.75	1.25	1.10	.46	.69	.67
8	.42	.67	.67	.83	1.25	1.85	.75	1.25	1.12	.48	.73	.67
9	.42	.67	.69	.88	1.29	1.92	.75	1.26	.96	.42	.81	.67
10	.42	.64	.73	.88	1.33	1.92	.75	1.25	.88	.40	.76	.67
11	.42	.62	.75	.88	1.38	2.00	.75	1.21	.88	.38	.71	.69
12	.42	.67	.75	.90	1.42	2.00	.83	1.17	.90	.38	.65	.67
13	.38	.67	.82	.88	1.46	2.00	1.50	1.17	.90	.38	.52	.67
14	.42	.67	.82	.85	1.50	2.00	1.29	1.19	.90	.48	.54	.69
15	.42	.64	.79	.88	1.52	1.83	1.26	1.21	.85	.50	.58	.67
16	.42	.62	.75	.85	1.50	1.92	1.31	1.17	.88	.50	.71	.67
17	.42	.64	.67	.88	1.46	1.99	1.29	1.21	.88	.50	.75	.67
18	.42	.64	.58	.92	1.46	2.08	1.29	1.19	.88	.50	.88	.67
19	.50	.67	.58	.96	1.50	2.05	1.29	1.21	.88	.50	1.17	.67
20	.46	.67	.58	.92	1.48	2.06	1.21	1.21	.85	.54	1.17	.67
21	.50	.67	1.42	.94	1.46	2.00	1.27	1.23	.83	.56	1.12	.67
22	.54	.64	1.38	1.00	1.50	1.75	1.25	1.17	.83	.58	1.10	.67
23	.50	.64	1.33	1.05	1.54	1.75	1.08	1.17	.79	.58	1.12	.67
24	.54	.64	1.25	1.08	1.64	1.62	1.00	1.17	.79	.60	1.17	.67
25	.54	.64	1.17	1.17	1.71	1.58	.96	1.17	.79	.60	1.17	.77
26	.54	.58	1.00	1.25	1.90	1.56	.92	1.14	.75	.60	1.08	.65
27	.58	.62	1.00	1.17	1.96	1.25	.92	1.17	.75	.60	1.08	.67
28	.54	.67	1.12	1.12	2.08	1.17	.92	1.17	.71	.62	1.00	.62
29	.58	.....	1.17	1.10	2.08	1.21	.94	1.14	.71	.62	.96	.62
30	.58	.....	1.12	1.08	2.00	1.08	.92	1.14	.69	.62	.94	.60
31	.58	.....	1.08	.....	1.94	.....	.92	1.17	.....	.67	.....	.62

Daily discharge, in second-feet, of Salmon Creek near Okanogan, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	7.4	7.4	11	34	26	121	23	50	43	11	11	23
2	7.4	8.8	11	29	29	150	21	50	43	8.0	12	21
3	6.8	8.8	12	29	58	97	18	50	39	7.4	11	14
4	7.4	11	11	26	85	97	18	50	39	6.2	11	12
5	6.2	12	11	26	75	108	12	50	39	6.2	11	12
6	5.0	11	11	23	54	108	12	50	39	5.0	11	11
7	4.2	11	11	23	50	121	14	50	37	4.2	12	11
8	3.4	11	11	18	50	124	14	50	39	4.6	14	11
9	3.4	11	12	21	54	136	14	51	26	3.4	18	11
10	3.4	9.6	14	21	58	136	14	50	21	3.0	15	11
11	3.4	8.8	14	21	63	150	14	47	22	2.9	12	12
12	3.4	11	14	22	67	150	18	43	22	2.9	10	11
13	2.9	11	18	21	71	150	75	43	22	2.9	5.6	11
14	3.4	11	18	20	75	150	54	45	22	4.6	6.2	12
15	3.4	9.6	16	21	77	121	51	47	20	5.0	7.4	11
16	3.4	8.8	14	20	75	136	56	43	21	5.0	12	11
17	3.4	9.6	11	21	71	148	54	47	21	5.0	14	11
18	3.4	9.6	7.4	23	71	166	54	45	21	5.0	21	11
19	5.0	11	7.4	26	75	160	54	47	21	5.0	43	11
20	4.2	11	7.4	23	73	162	47	47	20	6.2	43	11
21	5.0	11	67	25	71	150	52	49	18	6.8	39	11
22	6.2	9.6	63	29	75	108	50	43	18	7.4	37	11
23	5.0	9.6	58	33	80	108	35	43	16	7.4	39	11
24	6.2	9.6	50	35	93	90	29	43	16	8.0	43	11
25	6.2	9.6	43	43	102	85	26	43	16	8.0	43	11
26	6.2	7.4	29	50	132	82	23	41	14	8.0	35	10
27	7.4	8.8	29	43	143	50	23	43	14	8.0	35	11
28	6.2	11	39	39	166	43	23	43	12	8.8	29	8.8
29	7.4	.....	43	37	166	47	25	41	12	8.8	26	8.8
30	7.4	.....	39	35	150	35	23	41	12	8.8	25	8.0
31	7.4	.....	34	.....	139	.....	23	43	.....	11	.....	8.8

NOTE.—These discharges are based on a rating curve that is poorly defined and daily discharges are only approximate.

Monthly discharge of Salmon Creek near Okanogan, Wash., for 1909.

[Drainage area, 152 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January	7.4	2.9	5.20	0.034	0.04	320
February	12	7.4	9.99	.066	.07	555
March	67	7.4	23.7	.156	.18	1,460
April	50	18	27.9	.184	.21	1,660
May	166	26	83.0	.546	.63	5,100
June	166	35	116	.763	.85	6,900
July	75	12	31.3	.206	.24	1,920
August	51	41	46.1	.303	.35	2,830
September	43	12	24.2	.159	.18	1,440
October	11	2.9	6.27	.041	.05	386
November	43	5.6	21.7	.143	.16	1,290
December	23	8.0	11.6	.076	.09	713
The year	166	2.9	33.9	.223	3.05	24,600

NOTE.—These estimates are only roughly approximate.

METHOW RIVER DRAINAGE BASIN.

DESCRIPTION.

Methow River rises on the eastern slope of the Cascade Mountains in the northern part of Okanogan County and flows southeastward, uniting with Columbia River near Pateros. It is about 60 miles long, and its drainage basin, which lies west of the Okanogan Basin and east of the basin of Chelan Lake, comprises about 1,700 square miles. The most important tributaries of the Methow are its East Fork, which joins it near Winthrop, and Twisp River, which enters from the west at Twisp.

The country is rough and mountainous and lightly forested. The mean annual rainfall ranges from 70 to 80 inches on the summit of the Cascades to about 15 inches at the mouth of the river. Irrigation is not practiced except on the lands lying contiguous to the streams. A project is now under way whereby a large portion of the water will be used for the irrigation of bench lands in the vicinity of Brewster. The climatic conditions are favorable for intensive agriculture.

METHOW RIVER AT PATEROS, WASH.

This station was first established May 3, 1903, about one-fourth mile above the old county bridge at Pateros, Wash., and then moved, June 17, 1903, about one-half mile upstream.

The inclined gage at the new location is fastened to two pine trees on the left bank and out of the influence of backwater from Columbia River. The first two discharge measurements were made from the county bridge. This bridge washed out in the summer of 1903 and

subsequent measurements were made from a temporary bridge near by. On June 4, 1904, a cable was installed 500 feet above the gage.

No tributaries enter in the immediate vicinity of the station. During the winter months observations are sometimes complicated by ice, although the difficulty has not been serious.

The conditions at the station are favorable for good results, and it is believed that the records are fairly reliable considering the few measurements made.

Discharge measurements of Methow River at Pateros, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 19	Howard Kimble	207	1,200	8.80	7,760
Oct. 16	do	153	320	3.98	417

Daily gage height, in feet, of Methow River, at Pateros, Wash., for 1909.

[W. Plessinger and F. W. Robinson, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.95	.....	4.17	4.30	5.20	8.72	6.95	5.45	4.20	4.10	4.02	4.90
2	3.95	.....	4.12	4.29	5.25	10.25	7.00	5.40	4.18	4.10	4.06	4.75
3	3.90	.....	4.12	4.28	5.50	10.50	7.05	5.30	4.15	4.08	4.14	4.42
4	3.90	.....	4.11	4.28	6.05	9.82	7.05	5.20	4.13	4.08	4.18	4.31
5	3.95	.....	3.98	4.28	6.25	9.35	7.15	5.10	4.10	4.06	4.15	4.35
6	3.95	.....	3.81	4.30	6.10	8.95	7.45	5.05	4.10	4.05	4.11	4.42
7	.....	.....	3.80	4.31	5.90	8.50	7.82	5.00	4.08	4.05	4.08	4.42
8	.....	.....	3.78	4.32	5.85	8.30	7.95	4.95	4.08	4.03	4.12	4.43
9	.....	.....	3.78	4.36	5.85	8.42	7.72	4.90	4.05	4.03	4.12	4.42
10	.....	.....	3.79	4.42	6.00	8.85	7.60	4.85	4.05	4.02	4.12	4.42
11	.....	.....	3.79	4.50	5.90	9.28	7.35	4.80	4.03	4.02	4.10	4.40
12	.....	.....	3.80	4.60	5.90	9.60	7.00	4.70	4.02	4.00	4.08	4.35
13	.....	.....	3.82	4.70	6.00	9.30	6.80	4.65	4.00	4.00	4.05	4.30
14	.....	.....	3.82	4.80	6.15	8.92	6.60	4.65	3.98	4.00	4.00	4.24
15	.....	.....	3.84	4.90	6.30	9.08	6.50	4.60	3.96	3.98	3.98	4.18
16	.....	.....	3.85	4.90	6.35	9.20	6.45	4.55	3.94	3.98	4.02	4.23
17	.....	.....	3.87	4.85	6.35	8.95	6.40	4.50	3.94	4.00	4.02	4.20
18	.....	.....	3.89	4.85	6.35	8.82	6.30	4.45	3.92	4.00	4.02	4.22
19	.....	.....	3.89	4.87	6.40	8.75	6.15	4.40	3.93	4.02	4.07	4.22
20	.....	.....	3.89	4.90	6.45	8.58	6.05	4.35	3.95	4.00	4.09	4.05
21	.....	4.25	3.90	4.90	6.45	8.42	5.95	4.35	3.95	4.00	4.09	3.93
22	.....	4.15	3.90	4.95	6.35	8.28	5.85	4.34	3.96	3.98	4.12	3.92
23	.....	4.15	3.90	5.00	6.40	7.90	5.80	4.32	3.96	3.98	4.18	3.97
24	.....	3.85	3.92	5.10	6.70	7.60	5.75	4.30	3.96	3.98	4.32	4.05
25	.....	3.75	3.95	5.20	7.08	7.40	5.75	4.28	3.95	3.98	4.36	4.13
26	.....	3.65	4.00	5.30	7.95	7.30	5.70	4.30	3.96	3.98	4.29	4.21
27	.....	3.95	4.07	5.35	8.48	7.30	5.65	4.32	3.98	3.97	4.20	4.32
28	.....	4.20	4.16	5.35	8.70	7.10	5.60	4.32	4.03	3.97	4.25	4.30
29	.....	.....	4.30	5.25	8.25	6.90	5.55	4.30	4.07	3.98	4.30	4.30
30	.....	.....	4.30	5.20	7.88	6.90	5.50	4.27	4.10	3.98	4.70	4.40
31	.....	.....	4.29	.....	7.88	.....	5.50	4.23	.....	4.00	.....	4.40

NOTE.—Flow affected by ice conditions from Jan. 7 to Mar. 5 and Dec. 2 to 31. Ice covered entire channel Jan. 7 to Feb. 18; broke up Feb. 19. Half of channel full of ice Feb. 24. River cleared Mar. 6. River full of broken ice Dec. 2 to 4. Ice along shores Dec. 17. Ice jam about 400 feet below gage from Dec. 19 to 31 and river about two-thirds frozen over.

Daily discharge, in second-feet, of Methow River at Pateros, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	407	390	501	569	1,270	7,340	3,830	1,540	515	468	434	984
2	407	390	477	564	1,320	10,600	3,920	1,480	506	468	451	864
3	388	390	477	558	1,600	11,200	4,010	1,370	492	460	487	640
4	388	390	473	558	2,350	9,690	4,010	1,270	482	460	506	575
5	407	390	418	558	2,650	8,680	4,200	1,170	468	451	492	598
6	407	390	357	569	2,420	7,820	4,770	1,120	468	447	473	640
7	390	390	354	575	2,130	6,880	5,500	1,070	460	447	460	640
8	390	390	348	581	2,060	6,470	5,760	1,030	460	439	477	646
9	390	390	348	604	2,060	6,720	5,300	984	447	439	477	640
10	390	390	351	640	2,270	7,610	5,070	943	447	434	477	640
11	390	390	351	690	2,130	8,530	4,580	902	439	434	468	627
12	390	390	354	756	2,130	9,220	3,920	826	434	426	460	598
13	390	390	361	826	2,270	8,570	3,560	791	426	426	447	569
14	390	390	361	902	2,500	7,760	3,220	791	418	426	426	537
15	390	390	368	984	2,730	8,100	3,050	756	411	418	418	506
16	390	390	371	984	2,800	8,360	2,970	723	403	418	434	531
17	390	390	378	943	2,800	7,820	2,880	690	403	426	434	515
18	390	390	385	943	2,800	7,550	2,730	658	396	426	434	526
19	390	390	385	959	2,880	7,400	2,500	627	399	434	455	526
20	390	390	385	984	2,970	7,050	2,350	598	407	426	464	447
21	390	390	388	984	2,970	6,720	2,200	598	407	426	464	399
22	390	390	388	1,030	2,800	6,430	2,060	592	411	418	477	396
23	390	390	388	1,070	2,880	5,660	1,990	581	411	418	506	415
24	390	390	396	1,170	3,390	5,070	1,920	569	411	418	581	380
25	390	339	407	1,270	4,070	4,680	1,920	558	407	418	604	410
26	390	312	426	1,370	5,760	4,480	1,850	569	411	418	564	442
27	390	407	455	1,430	6,840	4,480	1,790	581	418	415	515	494
28	390	515	496	1,430	7,300	4,110	1,720	581	439	415	542	484
29	390	.....	569	1,320	6,370	3,740	1,660	569	455	418	569	484
30	390	.....	569	1,270	5,620	3,740	1,600	553	468	418	826	533
31	390	.....	564	.....	5,620	.....	1,600	531	.....	426	.....	533

NOTE.—These discharges are based on a rating curve that is fairly well defined from 425 to 8,000 second-feet except as follows: Jan. 7 to Feb. 24, daily discharges estimated as 390 second-feet and discharges Dec. 24 to 31 reduced 15 per cent from open-water rating to allow for ice conditions.

Monthly discharge of Methow River at Pateros, Wash., for 1909.

[Drainage area, 1,710 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	407	388	[a] 392	0.229	0.26	24,100	D.
February	515	312	[a] 390	.228	.24	21,700	D.
March	569	348	414	.242	.28	25,500	C.
April	1,430	558	903	.528	.59	53,700	B.
May	7,300	1,270	3,220	1.88	2.17	198,000	B.
June	11,200	3,740	7,080	4.14	4.62	421,000	B.
July	5,760	1,600	3,180	1.86	2.14	196,000	B.
August	1,540	531	824	.482	.56	50,700	B.
September	515	396	437	.256	.29	26,000	C.
October	468	415	432	.253	.29	26,600	C.
November	826	418	494	.289	.32	29,400	C.
December	984	380	555	.325	.37	34,100	D.
The year	11,200	312	1,527	.896	12.13	1,110,000	

[a] Partly estimated.

CHELAN RIVER DRAINAGE BASIN.

DESCRIPTION.

Chelan River forms the outlet of Lake Chelan in Chelan County, Wash. The river, which joins Columbia River at Chelan Falls, Wash., is only 4 miles long and in this distance has a fall of 380 feet, which as yet has not been utilized for power development.

Chelan Lake is a narrow body of water, 48 miles long and about 1 mile wide, lying at an elevation of 1,080 feet above sea level. It is fed by mountain streams which have their sources in the glaciers of the Cascade Range. Owing to its great depth and to the mild temperature of the region, the lake is open to navigation for the whole year. The area contiguous to the lake is exceedingly rugged and mountainous and is lightly forested. The mean annual rainfall at Chelan is about 13 inches.

CHELAN RIVER AT CHELAN, WASH.

This station was established November 6, 1903, at a highway bridge 3,000 feet below the outlet of Chelan Lake, 4 miles northwest of Chelan Falls, in the town of Chelan, Wash.

Discharge measurements prior to 1906 were made from the new highway bridge half a mile above the gage and above a dam at the outlet of the lake. This dam partially controls the flow of the river. Since 1906 discharge measurements have been made at the lower bridge where the staff gage is located. The gage datum has remained unchanged. High-water measurements can best be made at the upper bridge.

The data obtained here are valuable for use in future water-power developments.

Discharge measurements of Chelan River at Chelan, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 14	Howard Kimble	242	2,510	10.05	8,050
15[a]	do.	330	1,770	10.15	8,570

[a] Made at upper highway bridge.

Daily gage height, in feet, of Chelan River at Chelan, Wash., for 1909.

[G. Vern Richardson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.15	5.1	4.95	5.1	6.7	8.85	9.3	7.65	5.8	5.5	5.2	6.95
2	5.2	5.1	4.9	5.15	6.75	9.0	9.25	7.6	5.8	5.45	5.25	6.8
3	5.15	5.05	4.9	5.2	6.75	9.2	9.2	7.5	5.8	5.4	5.35	6.85
4	5.1	5.0	4.85	5.25	6.7	9.4	9.15	7.45	5.8	5.45	5.3	6.95
5	5.1	5.0	4.85	5.3	6.7	9.6	9.1	7.35	5.8	5.45	5.3	6.85
6	5.05	4.95	4.9	5.3	6.65	9.6	9.05	7.3	5.85	5.5	5.25	6.8
7	5.05	4.95	7.1	5.35	6.6	9.6	9.15	7.25	5.9	5.55	5.25	6.8
8	5.05	4.95	7.0	5.3	6.6	9.7	9.15	7.15	5.95	5.6	5.3	6.85
9	5.0	5.0	6.95	5.25	6.6	9.75	9.1	7.1	5.95	5.6	5.35	6.75
10	5.0	5.0	6.9	5.2	6.7	9.85	9.1	7.0	6.0	5.55	5.3	6.8
11	5.0	4.95	6.9	5.2	6.75	9.95	9.1	4.65	6.0	5.5	5.2	6.85
12	5.0	4.95	6.8	7.0	6.8	10.0	9.05	4.6	6.0	5.6	5.15	6.8
13	4.95	4.9	6.7	6.85	6.8	10.05	9.0	4.6	6.05	5.5	5.15	6.9
14	4.9	4.95	6.6	6.75	6.85	10.05	9.0	4.55	6.05	5.5	5.1	6.65
15	4.9	4.95	6.5	6.6	6.8	10.1	8.95	4.75	6.0	5.45	5.2	6.6
16	4.95	5.0	6.4	6.5	6.8	10.15	8.9	4.9	5.95	5.35	5.25	6.55
17	4.9	5.1	6.25	6.5	6.9	10.2	8.85	4.95	5.95	5.4	5.25	5.45
18	4.95	5.1	6.1	6.45	6.95	10.2	8.7	5.0	5.9	5.4	5.3	6.3
19	4.95	5.0	5.95	6.45	7.05	10.25	8.55	5.1	5.95	5.35	5.35	6.2
20	4.95	5.0	5.85	6.5	7.1	10.2	8.4	5.2	5.95	5.25	5.3	6.15
21	4.9	5.05	5.8	6.55	7.3	10.15	8.25	5.25	6.0	5.2	5.45	6.1
22	4.9	5.05	5.7	6.6	7.35	10.1	8.15	5.3	6.1	5.2	5.5	6.0
23	4.8	5.1	4.9	6.75	7.65	10.0	8.1	5.4	6.05	5.25	5.6	6.05
24	4.8	5.05	4.95	6.7	7.75	9.9	8.0	5.45	5.95	5.3	5.75	6.1
25	4.8	5.0	5.0	6.65	7.85	9.75	7.95	5.5	5.95	5.35	6.1	6.0
26	4.75	4.95	5.05	6.6	7.9	9.6	7.9	5.5	5.85	5.25	6.2	5.95
27	4.75	4.9	5.05	6.6	7.95	9.55	7.85	5.55	5.85	5.2	6.35	5.90
28	4.8	4.95	5.1	6.65	8.0	9.55	7.8	5.6	5.75	5.15	6.4	5.85
29	4.8	.....	5.1	6.65	8.1	9.5	7.75	5.65	5.65	5.1	6.65	5.8
30	4.9	.....	5.15	6.7	8.3	9.4	7.7	5.7	5.55	5.1	6.8	5.7
31	5.0	.....	5.15	.....	8.6	.....	7.7	5.75	.....	5.2	.....	5.65

Daily discharge, in second-feet, of Chelan River at Chelan, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	685	660	588	660	2,050	5,780	6,640	3,540	1,090	880	710	2,400
2	710	660	565	685	2,120	6,070	6,540	3,450	1,090	850	738	2,190
3	685	635	565	710	2,120	6,450	6,450	3,270	1,090	820	792	2,260
4	660	660	542	738	2,050	6,830	6,360	3,180	1,090	850	765	2,400
5	660	660	542	765	2,050	7,210	6,260	3,020	1,090	850	765	2,260
6	635	588	565	765	1,980	7,210	6,160	2,940	1,130	880	738	2,190
7	635	588	2,630	792	1,920	7,210	6,360	2,860	1,170	880	738	2,190
8	635	588	2,480	765	1,920	7,400	6,360	2,700	1,220	950	765	2,260
9	610	610	2,400	738	1,920	7,500	6,260	2,630	1,220	950	792	2,120
10	610	610	2,330	710	2,050	7,700	6,260	2,480	1,260	915	765	2,190
11	610	588	2,330	710	2,120	7,900	6,260	460	1,260	880	710	2,260
12	610	588	2,190	2,480	2,190	8,000	6,160	440	1,260	950	685	2,190
13	688	565	2,050	2,260	2,190	8,100	6,070	440	1,310	880	685	2,330
14	565	588	1,920	2,120	2,260	8,100	6,070	422	1,310	880	660	1,980
15	565	588	1,800	1,920	2,190	8,200	5,980	500	1,260	850	710	1,920
16	565	610	1,680	1,800	2,190	8,300	5,880	565	1,220	792	738	1,860
17	565	660	1,500	1,800	2,330	8,400	5,780	588	1,220	820	738	1,740
18	588	660	1,360	1,740	2,400	8,400	5,500	610	1,170	820	765	1,570
19	588	610	1,220	1,740	2,560	8,500	5,220	660	1,220	792	792	1,460
20	588	610	1,130	1,800	2,630	8,400	4,930	710	1,220	738	765	1,410
21	565	635	1,090	1,860	2,940	8,300	4,640	738	1,260	710	850	1,360
22	565	635	1,020	1,920	3,020	8,200	4,460	765	1,360	710	880	1,260
23	520	660	565	2,120	3,540	8,000	4,360	820	1,310	738	950	1,310
24	520	635	588	2,050	3,720	7,800	4,170	850	1,220	765	1,060	1,360
25	520	610	610	1,980	3,900	7,500	4,080	880	1,220	792	1,360	1,260
26	500	588	635	1,920	3,990	7,210	3,990	880	1,130	738	1,460	1,220
27	500	565	635	1,920	4,080	7,120	3,900	915	1,300	710	1,620	1,170
28	520	588	660	1,980	4,710	7,120	3,810	950	1,060	685	1,680	1,130
29	520	.....	660	1,980	4,360	7,020	3,720	985	985	660	1,980	1,090
30	565	.....	685	2,050	4,740	6,830	3,630	1,020	915	660	2,190	1,020
31	610	.....	685	.....	5,310	.....	3,630	1,060	.....	710	.....	985

NOTE.—These discharges are based on a rating curve that is fairly well defined above 880 second-feet. From Aug. 10 to 14 water was being stored by use of flashboards on the dams.

Monthly discharge of Chelan River at Chelan, Wash., for 1909.

[Drainage area, 950 square miles.]

Month.	Discharge in second feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	710	500	592	0.623	0.72	36,400	C.
February	660	565	616	.648	.67	34,200	C.
March	2,630	542	1,230	1.29	1.49	75,600	B.
April	2,480	660	1,520	1.60	1.78	90,400	B.
May	5,310	1,920	2,810	2.96	3.41	173,000	B.
June	8,500	5,780	7,560	7.96	8.88	450,000	B.
July	6,640	3,630	5,350	5.63	6.49	329,000	B.
August	3,540	422	1,460	1.54	1.78	89,800	C.
September	1,360	915	1,180	1.24	1.38	70,200	C.
October	950	660	810	.853	.98	49,800	C.
November	2,190	660	962	1.01	1.13	57,200	C.
December	2,400	985	1,750	1.84	2.12	108,000	C.
The year	8,500	422	2,150	2.27	30.83	1,560,000	

WENATCHEE RIVER DRAINAGE BASIN.

DESCRIPTION.

Wenatchee River rises in Cady Pass, at an elevation of 4,500 feet, flows southeastward, passing through Wenatchee Lake at an elevation of 1,870 feet, and empties into Columbia River at the town of Wenatchee, Wash. With its tributaries it drains a stretch of the eastern slope of the Cascade Mountains about 40 miles long and the territory north of the Yakima River drainage basin, from which it is separated by the Wenatchee Mountains.

The river has a number of tributaries, among which may be mentioned North Fork River, which flows into Wenatchee Lake near its head, and Chiwawa, Nason, Chumstick, Icicle, Peshastin, and Mission creeks. The upper part of the drainage area is heavily forested, but the extreme lower part consists of timberless hills and ridges, in most places covered with sagebrush.

The mean annual precipitation at Wenatchee is 16 inches, a large part of it being in the form of snow. During portions of the winter the streams are icebound.

The data obtained are used in connection with the development of irrigation and water power. The Great Northern Railway has recently built a hydroelectric plant at Leavenworth, where about 7,000 horsepower is developed to operate trains through the Cascade tunnel.

WENATCHEE RIVER AT SHERMAN SPUR, NEAR DRYDEN, WASH.

This station was established April 27, 1909, by the Valley Power Co. at their power plant at Sherman Spur, a station on the Great Northern Railway, near Dryden post office and about 6 miles

above Cashmere, Wash. It is about 500 feet below the Great Northern Railway bridge, and about 1 mile below the head gate of High-Line canal.

The gage is a vertical staff fastened to the cribwork opposite the power house, and is practically in the tailrace of the power plant. No equipment for measuring discharge has been installed.

Gage heights have been furnished by the Valley Power Co.

Daily gage height, in feet, of Wenatchee River at Sherman Spur, near Dryden, Wash., for 1909.

[Power Valley Co., observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.1	5.15	3.3	1.4	0.4	0.5	0.28	7.05
2	.....	2.22	6.45	3.4	1.35	.4	.32	.95	6.1
3	.....	2.65	6.65	3.45	1.25	.4	.28	2.5	4.15
4	.....	3.1	6.2	3.6	1.2	.42	.2	2.4	3.2
5	.....	2.5	5.6	3.55	1.08	.4	.1	1.98	2.9
6	.....	3.85	5.05	3.5	.95	.42	.18	1.6	2.7
7	.....	2.62	4.75	3.6	.9	.5	.25	1.38	2.45
8	.....	2.32	4.45	3.3	.9	.45	.38	1.25	2.2
9	.....	2.5	4.75	3.1	.92	.4	.3	1.2	2.2
10	.....	2.5	5.1	2.9	.65	.32	.68	1.05	2.1
11	.....	2.45	5.6	2.8	.8	.3	.65	.95	2.0
12	.....	2.4	5.75	2.7	.8	.25	.55	.85	2.15
13	.....	2.4	5.2	2.45	.78	.2	.4	.78	2.45
14	.....	2.55	5.0	2.4	.7	.15	.35	.72	2.15
15	.....	2.7	5.3	2.4	.7	.05	.3	.6	2.05
16	.....	2.75	5.15	2.4	.7	.0	.3	.55	1.8
17	.....	2.82	4.85	2.18	.6	−.1	.2	.55	1.7
18	.....	2.62	4.65	2.0	.58	−.1	.0	1.2	1.6
19	.....	3.0	4.7	1.9	.85	−.05	−.05	2.9	1.5
20	.....	3.15	4.6	1.85	.4	.0	.0	2.65	1.4
21	.....	2.95	4.55	1.7	.6	.25	.1	2.25	1.15
22	.....	2.82	4.1	1.9	.65	.35	.15	2.3	1.1
23	.....	2.88	3.85	2.02	.45	.25	.2	5.0	1.0
24	.....	3.25	3.6	1.9	.38	.1	.18	5.7	1.0
25	.....	3.72	3.35	1.8	.35	.12	.3	4.25	1.0
26	2.5	4.3	3.3	1.85	.38	.3	.22	3.35	1.0
27	2.38	4.7	3.4	1.8	.88	.3	.2	2.7	.95
28	2.35	4.5	3.25	1.65	.72	.1	.15	2.9	.9
29	2.2	4.2	2.95	1.6	.55	.25	.12	5.2	.8
30	2.1	3.75	3.1	1.55	.5	.58	.12	7.5	.8
31	.....	3.78	.....	1.5	.42	.....	.1	.....	.9

WENATCHEE RIVER AT CASHMERE, WASH.

This station was originally established July 26, 1904, at the highway bridge in Cashmere, Wash., 1½ miles below the mouth of Mission Creek and 8 miles above the mouth of the river. The bridge was rebuilt during the summer of 1907 and the staff gage removed, readings being taken from the temporary gages set by the observer. On September 28, 1908, the staff gage was replaced on the bridge at the same datum and the gage heights for the intervening period reduced to this datum. These gage heights, however, are liable to considerable error.

Gage heights were resumed June 20, 1909, and continued until October 12. On October 13, 1909, the station was moved 1 mile above its former location to a new highway bridge, called the upper bridge, on the main road from Cashmere to Leavenworth, where conditions for gaging are much better. A chain gage was installed on the bridge. Discharge measurements are made from the bridge. Gage heights for 1907 and 1908 were published in Water-Supply Paper 252, page 132. Daily and monthly estimates of discharge for 1904 to 1906 have been revised on the basis of later measurements and supersede those published in Water-Supply Papers 178, page 42, and 211, page 40.

Discharge measurements of Wenatchee River at Cashmere, Wash., in 1904–1906, 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1904.					
July 26	W. G. Steward	197	1,170	3.88	3,650
1905.					
Oct. 30	do	187	960	2.90	2,220
Nov. 3	do	185	894	2.48	1,990
14	do	164	799	1.98	1,360
25	do	162	784	1.87	1,210
1906.					
Aug. 23	do [a]	160	232	1.55	889
29	do [a]	161	737	1.55	956
Dec. 27	H. D. McGlashan [a]	186	312	2.20	1,300
1908.					
Sept. 28	L. R. Allen	109	344	.90	665
1909.					
June 12	H. Kimble [b]	273	1,820	7.70	17,600
Oct. 13	do [b]	215	524	1.28	1,230
18	do [b]	212	472	1.00	981
Dec. 10	do [b]	238	839	2.70	3,340

[a] Made at upper bridge.
[b] Made at new location, upper bridge. Gage heights refer to new gage.

Daily gage height, in feet, of Wenatchee River at Cashmere, Wash., for 1909.

[Lower bridge, Eli Charbonneau, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1		5.3	2.5	1.8	1.9	16		4.1	2.2	1.3	
2		5.4	2.3	1.7	1.8	17		4.0	2.1	1.3	
3		5.6	2.4	1.8	1.7	18		3.9	2.0	1.3	
4		5.6	2.5	1.9	1.6	19		3.7	1.9	1.2	
5		5.7	2.5	2.0	1.6	20	6.8	3.6	1.7	1.2	
6		5.5	2.5	1.9	1.8	21	6.6	3.6	2.0	1.3	
7		5.7	2.5	1.7	2.0	22	6.4	3.7	1.9	1.3	
8		5.2	2.6	1.6	2.2	23	6.0	3.8	1.8	1.4	
9		4.9	2.6	1.7	2.0	24	5.4	3.6	1.7	1.5	
10		5.1	2.6	1.7	2.0	25	5.4	3.6	1.7	1.4	
11		4.8	2.2	1.6	2.1	26	5.3	3.5	2.3	1.3	
12		4.7	2.3	1.6	2.2	27	5.3	3.2	2.6	1.2	
13		4.5	2.3	1.5		28	5.2	3.3	2.3	1.3	
14		4.4	2.3	1.4		29	5.2	3.2	2.0	1.5	
15		4.3	2.3	1.4		30	5.2	3.2	2.0	2.1	
						31		3.1	1.8		

Daily gage height, in feet, of Wenatchee River at Cashmere, Wash., for 1909—Continued.

[Upper bridge, Paul Kinney, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1		1.06	6.9	11		1.8	2.9	21	0.93	3.0	1.95
2		1.17	5.5	12		1.7	2.85	22	.97	2.9	1.8
3		2.95	4.7	13	1.28	1.5	3.2	23	.93	5.85	1.65
4		3.55	4.05	14		1.3	2.9	24	.93	6.7	1.9
5		3.0	3.95	15		1.35	2.7	25	1.13	5.25	1.95
6		2.6	3.56	16		1.3	2.6	26	1.05	4.85	1.8
7		2.25	3.45	17	1.03	1.35	2.45	27	1.03	3.95	1.8
8		2.15	3.0	18	.97	2.0	2.25	28	.95	4.3	1.8
9		2.0	2.9	19	.9	3.5	2.15	29	.95	6.55	1.7
10		1.85	2.87	20	.9	3.65	2.13	30	.97	7.75	1.73
								31	.99		1.8

Daily discharge, in second-feet, of Wenatchee River at Cashmere, Wash., for 1904–1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.							1904.						
1		3,180	1,480	1,030	730	1,590	16		1,940	960	830	830	1,480
2		3,180	1,380	1,030	780	1,590	17		1,820	960	830	1,280	1,480
3		3,180	1,280	960	780	1,480	18		1,820	960	830	1,110	1,590
4		3,000	1,280	960	780	1,380	19		1,700	960	780	1,110	1,480
5		3,000	1,280	890	780	1,280	20		1,700	960	780	1,190	1,590
6		2,820	1,190	830	780	1,190	21		1,590	890	780	1,480	1,590
7		2,820	1,190	830	780	1,190	22		1,480	890	830	1,700	1,480
8		2,820	1,190	780	690	1,110	23		1,380	960	780	1,940	1,480
9		2,820	1,280	780	730	1,110	24		1,330	960	780	1,700	1,380
10		2,660	1,280	730	780	1,110	25		1,280	890	730	1,480	1,190
11		2,350	1,190	1,110	780	1,110	26		1,280	890	730	1,380	1,190
12		2,070	1,190	1,280	780	1,030	27	4,260	1,280	890	730	1,380	1,110
13		1,940	1,190	1,110	780	1,030	28	4,260	1,280	830	730	1,480	1,110
14		1,940	1,030	960	780	1,110	29	3,800	1,700	830	730	1,820	1,110
15		1,940	1,030	890	780	1,380	30	3,380	1,700	960	730	1,700	1,110
							31	3,180	1,590		730		1,110

Daily discharge, in second-feet, of Wenatchee River at Cashmere, Wash., for 1904–1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
1	1,110	690	1,820	2,660	5,760	14,100	7,200	2,350	960	1,190	1,940	1,190
2	1,110	690	2,210	2,500	5,240	14,500	6,900	2,350	960	1,190	1,820	1,190
3	1,110	730	3,800	2,350	4,980	14,500	7,200	2,350	960	4,260	1,820	1,280
4	1,110	780	4,740	2,350	4,740	14,900	6,900	2,210	960	8,760	1,820	1,190
5	1,030	780	4,980	2,210	4,740	12,800	6,600	2,070	960	5,240	1,700	1,110
6	890	780	4,980	2,500	5,240	11,600	6,320	1,940	960	5,760	1,590	1,190
7	890	830	4,740	2,660	6,040	11,200	5,760	1,820	960	4,980	1,590	1,110
8	890	780	4,740	2,820	7,500	11,600	5,500	1,820	960	4,260	1,480	1,190
9	890	730	4,980	3,000	8,760	13,200	5,760	1,820	1,190	3,380	1,480	1,110
10	830	690	5,500	3,000	8,120	14,100	6,040	1,940	1,280	2,820	1,380	1,030
11	780	650	6,040	3,000	7,200	14,100	5,760	1,820	1,190	2,660	1,380	960
12	780	1,110	6,040	3,180	6,600	13,200	5,240	1,820	1,110	2,500	1,380	890
13	830	1,110	5,240	3,580	6,600	12,000	4,740	1,700	1,110	2,210	1,280	830
14	830	1,110	4,740	3,800	6,600	10,100	4,020	1,700	1,030	2,070	1,280	830
15	830	1,110	4,500	3,580	7,200	9,100	3,580	1,590	1,030	2,070	1,280	830
16	890	1,110	4,260	3,580	6,900	8,760	3,180	1,480	960	1,940	1,190	830
17	890	1,110	4,500	3,380	6,600	8,120	3,000	1,380	890	1,820	1,190	890
18	860	1,110	5,240	3,380	6,600	7,800	3,000	1,380	890	1,700	1,280	960
19	890	1,110	5,240	3,580	6,320	8,120	2,820	1,380	890	1,590	1,380	960
20	890	1,030	4,980	4,020	6,040	8,760	3,000	1,280	890	1,480	1,380	890
21	890	960	4,980	4,500	5,760	8,760	3,180	1,280	1,030	1,480	1,280	890
22	830	890	4,740	4,980	5,500	9,100	3,580	1,190	1,190	1,380	1,280	830
23	830	830	4,500	6,320	5,240	9,100	3,800	1,380	1,190	1,380	1,190	780
24	890	890	4,260	8,280	4,980	8,760	4,020	1,110	1,110	1,380	1,190	830
25	890	1,110	4,020	10,900	4,740	8,440	3,580	1,030	1,110	4,500	1,190	830

Daily discharge, in second-feet, of Wenatchee River at Cashmere, Wash., for 1904-1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
26	830	1,590	4,020	11,400	4,980	8,440	3,380	1,030	1,110	4,740	1,280	890
27	890	1,700	3,580	10,500	6,040	8,120	3,180	1,030	1,820	3,800	1,380	890
28	960	1,700	3,380	9,100	7,500	8,440	3,000	1,030	1,480	3,000	1,280	890
29	890	.....	3,180	7,500	9,100	7,200	2,820	1,030	1,380	3,000	1,190	890
30	830	.....	3,000	6,600	9,780	6,900	2,500	1,030	1,280	2,660	1,190	890
31	730	.....	2,660	.....	11,600	.....	2,500	1,030	.....	2,210	.....	830
1906.												
1	780	1,700	1,280	3,580	10,500	6,040	3,580	1,480	1,110	890	2,820	.....
2	780	1,820	1,280	3,380	10,900	6,040	4,020	1,380	1,110	830	2,350	.....
3	830	1,940	1,280	3,000	11,600	6,900	4,740	1,280	1,030	890	2,210	.....
4	890	1,820	1,190	3,180	10,900	8,760	5,500	1,190	1,030	1,030	2,210	.....
5	1,030	1,820	1,190	3,580	10,100	8,120	5,760	1,280	960	1,030	2,350	.....
6	1,030	1,700	1,280	4,500	8,760	6,900	5,760	1,280	830	1,030	1,940	.....
7	960	1,700	1,280	5,500	8,120	6,040	6,320	1,280	830	1,030	1,940	.....
8	960	1,590	1,380	7,200	8,120	5,500	5,500	1,280	1,190	960	2,070	.....
9	890	1,480	1,480	6,040	8,440	4,980	4,740	1,280	1,700	890	2,070	.....
10	890	1,380	1,590	5,240	10,100	4,740	4,260	1,280	1,590	960	2,070	.....
11	890	1,380	1,590	4,980	11,200	4,500	3,800	1,280	1,280	890	3,180	.....
12	830	1,380	1,480	4,740	10,500	6,900	3,580	1,280	1,030	890	3,180	.....
13	830	1,280	1,380	4,500	9,780	7,200	3,580	1,280	960	1,030	9,440	.....
14	780	1,280	1,380	4,020	8,120	6,040	3,380	1,380	960	1,110	19,300	.....
15	830	1,280	1,280	4,260	8,120	5,240	3,180	1,280	960	1,280	.....	.....
16	830	1,190	1,280	4,980	6,900	5,240	3,000	1,190	960	1,700	.....	.....
17	830	1,190	1,280	5,500	6,040	4,980	2,820	1,150	890	2,070	.....	.....
18	830	1,280	1,280	5,240	5,500	4,500	2,660	1,110	890	2,500	.....	.....
19	780	1,590	1,280	5,240	5,240	4,260	2,500	960	830	2,210	.....	.....
20	780	1,820	1,280	5,500	4,980	4,020	2,350	960	830	2,070	.....	.....
21	780	1,700	1,280	6,600	4,980	4,020	2,210	960	830	1,590	.....	.....
22	830	1,590	1,280	9,960	4,740	4,020	2,070	960	830	1,480	.....	.....
23	890	1,590	1,280	9,780	4,980	4,020	2,070	960	830	1,380	.....	.....
24	1,110	1,480	1,280	9,100	4,980	4,260	1,940	890	830	1,280	.....	.....
25	1,590	1,480	1,380	8,120	5,240	4,740	1,820	890	890	1,110	.....	.....
26	1,700	1,380	1,480	7,200	8,440	5,500	1,820	960	1,110	12,400	.....	.....
27	1,700	1,380	1,590	6,900	8,760	5,240	1,700	1,030	1,110	10,500	.....	1,480
28	1,590	1,380	1,700	6,900	7,800	4,980	1,590	1,030	960	7,200	.....	1,480
29	1,590	.....	1,820	8,120	6,900	4,260	1,590	1,110	890	5,240	.....	1,380
30	1,480	.....	2,070	9,100	6,600	3,800	1,590	1,110	830	4,020	.....	1,380
31	1,590	.....	3,180	.....	6,320	.....	1,590	1,110	.....	3,380	.....	1,380
1907.												
1	1,380	960	2,660	1,820	6,320	19,000	6,600	2,660	1,110	1,110	1,120	2,350
2	1,340	960	2,500	1,940	6,320	16,700	6,320	2,660	1,190	1,110	1,120	2,070
3	1,300	960	2,500	2,070	7,500	14,500	6,040	2,660	1,480	1,110	1,130	2,070
4	1,270	1,030	2,350	2,070	8,440	13,600	5,760	2,500	1,380	1,110	1,130	1,940
5	1,230	1,030	2,350	2,070	9,440	13,600	5,500	2,350	1,280	1,110	1,140	1,820
6	1,190	1,030	2,210	2,210	10,900	12,800	5,500	2,070	1,190	1,110	1,140	1,820
7	1,190	1,110	2,210	2,210	12,400	11,600	5,240	1,820	1,110	1,110	1,140	1,820
8	1,110	1,760	2,210	2,210	13,200	10,100	4,980	1,700	1,110	1,110	1,150	1,820
9	1,110	3,000	2,210	2,660	12,800	9,100	4,980	1,700	1,110	1,110	1,150	1,700
10	1,030	4,260	2,210	4,020	12,000	8,440	5,240	1,280	1,280	1,110	1,160	1,700
11	1,030	3,580	2,210	4,260	12,000	8,440	5,500	1,380	1,280	1,110	1,160	1,700
12	1,030	3,380	2,070	4,260	10,500	8,440	5,240	1,380	1,380	1,110	1,170	1,700
13	1,030	3,180	2,070	4,500	9,780	7,500	4,980	1,280	1,280	1,110	1,170	1,700
14	1,030	3,000	2,070	5,760	9,440	6,600	4,260	1,190	890	1,110	1,170	1,700
15	1,030	2,660	2,070	5,500	11,600	6,320	4,260	1,190	960	1,110	1,180	1,590
16	960	2,500	2,070	5,760	15,400	5,760	4,020	1,190	1,280	1,110	1,180	1,480
17	960	2,500	1,940	5,760	16,700	5,500	4,020	1,190	1,280	1,110	1,190	1,280
18	960	2,350	1,940	5,500	17,200	5,760	3,800	1,110	1,700	1,110	1,190	1,190
19	960	2,210	1,820	5,500	17,600	7,200	3,800	1,110	1,480	1,110	1,190	1,280
20	960	2,500	1,700	5,240	16,700	8,440	3,580	1,190	1,280	1,110	1,190	1,480
21	960	3,000	1,940	4,980	14,500	8,760	4,260	1,190	1,190	1,110	1,190	1,590
22	960	3,180	1,280	5,760	12,800	7,800	3,580	1,190	1,280	1,110	1,190	1,590
23	960	3,180	1,940	6,600	12,000	7,200	3,380	1,280	1,190	1,110	1,190	1,700
24	960	3,000	1,940	7,500	11,600	7,200	3,380	1,280	1,190	1,110	1,380	1,820
25	960	3,000	1,820	7,200	11,600	7,800	3,180	1,480	1,190	1,110	1,590	1,820
26	960	2,820	1,820	7,200	11,200	11,200	3,180	2,070	1,110	1,110	1,480	1,820
27	960	2,820	1,820	6,900	12,800	10,100	3,000	1,380	1,110	1,110	1,480	1,820
28	890	2,660	1,820	6,600	14,100	10,100	2,820	1,280	1,110	1,110	1,480	1,820
29	890	.....	1,820	6,040	15,400	8,440	2,660	1,190	1,110	1,110	2,500	1,820
30	890	.....	1,700	6,040	16,300	6,900	2,500	1,190	1,110	1,110	2,420	1,820
31	890	.....	1,820	.....	18,500	.....	2,660	1,110	.....	1,110	.....	1,700

Daily discharge, in second-feet, of Wenatchee River at Cashmere, Wash., for 1904–1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1908.												
1	1,700	890	1,480	2,510	5,760	7,800	9,440	3,800	.....	.....	.....	.....
2	1,590	890	1,480	2,440	6,900	7,800	11,600	3,800	.....	.....	.....	.....
3	1,590	890	1,480	2,380	7,200	7,800	12,800	3,380	.....	.....	.....	.....
4	1,480	890	1,480	2,310	7,500	7,800	13,200	2,820	.....	.....	.....	.....
5	1,480	890	1,480	2,240	7,500	8,120	12,800	2,820	.....	.....	.....	.....
6	1,480	960	1,480	2,180	7,500	9,100	12,000	2,500	.....	.....	.....	.....
7	1,480	1,030	1,480	2,070	8,440	10,900	11,600	2,350	.....	.....	.....	.....
8	1,590	1,030	1,480	2,070	8,760	12,800	11,200	2,070	.....	.....	.....	.....
9	1,590	1,030	1,380	2,210	8,760	17,600	11,600	2,070	.....	.....	.....	.....
10	1,590	1,110	1,380	2,500	8,440	18,000	12,400	2,070	.....	.....	.....	.....
11	1,590	1,110	1,380	2,820	7,800	18,000	11,600	1,940	.....	.....	.....	.....
12	1,590	1,190	1,700	3,380	6,900	18,000	11,200	1,940	.....	.....	.....	.....
13	1,480	1,280	1,700	3,000	6,600	18,000	11,600	1,940	.....	.....	.....	.....
14	1,480	1,280	2,350	4,260	6,320	18,000	12,800	1,820	.....	.....	.....	.....
15	1,480	1,280	2,660	4,260	6,320	18,000	13,200	1,820	.....	.....	.....	.....
16	1,480	1,280	3,580	4,260	7,800	17,600	12,400	1,940	.....	.....	.....	.....
17	1,380	1,380	3,510	4,500	7,200	14,900	12,000	1,940	.....	.....	.....	.....
18	1,380	1,380	3,450	5,760	7,500	13,200	10,500	1,940	.....	.....	.....	.....
19	1,380	1,380	3,380	7,800	8,440	10,100	9,440	1,940	.....	.....	.....	.....
20	1,480	1,380	3,310	8,760	8,760	9,440	8,440	1,940	.....	.....	.....	.....
21	1,280	1,380	3,250	8,760	8,440	9,100	8,120	2,070	.....	.....	.....	.....
22	1,380	1,280	3,180	7,500	8,760	7,800	8,120	2,070	.....	.....	.....	.....
23	1,380	1,280	3,110	6,990	8,760	6,900	7,800	1,820	.....	.....	.....	.....
24	1,280	1,280	3,050	6,900	9,100	8,120	6,900	1,820	.....	.....	.....	.....
25	1,190	1,380	2,980	6,900	9,780	6,320	6,320	1,820	.....	.....	.....	.....
26	1,110	1,380	2,910	6,040	9,100	6,900	6,320	1,590	.....	.....	.....	.....
27	1,110	1,480	2,840	5,500	9,100	8,120	5,500	1,380	.....	.....	.....	.....
28	1,110	1,480	2,780	5,240	9,440	9,100	4,740	1,190	610	.....	.....	.....
29	1,030	1,480	2,710	5,500	9,440	10,900	4,020	1,100	.....	.....	.....	.....
30	1,030	.....	2,640	5,760	9,100	9,440	3,800	1,100	.....	.....	.....	.....
31	960	.....	2,580	.....	8,120	.....	3,800	1,100	.....	.....	.....	.....
1909.												
1	.....	.....	.....	.....	4,380	15,600	8,120	1,820	1,110	1,190	1,040	17,100
2	.....	.....	.....	.....	4,740	20,400	8,440	1,590	1,030	1,110	1,130	11,400
3	.....	.....	.....	.....	5,930	21,400	9,100	1,700	1,110	1,030	3,900	8,650
4	.....	.....	.....	.....	7,500	19,500	9,100	1,820	1,190	960	5,330	6,700
5	.....	.....	.....	.....	5,500	17,200	9,440	1,820	1,280	960	4,000	6,420
6	.....	.....	.....	.....	10,300	15,200	8,760	1,820	1,190	1,110	3,190	5,360
7	.....	.....	.....	.....	5,960	13,800	9,440	1,820	1,030	1,280	2,550	5,070
8	.....	.....	.....	.....	5,010	12,600	7,800	1,940	960	1,480	2,380	4,000
9	.....	.....	.....	.....	5,500	13,800	6,900	1,940	1,030	1,280	2,130	3,790
10	.....	.....	.....	.....	5,500	15,400	7,500	1,940	1,030	1,280	1,910	3,730
11	.....	.....	.....	.....	5,370	17,200	6,600	1,480	960	1,380	1,840	3,790
12	.....	.....	.....	.....	5,240	17,600	6,320	1,590	960	1,480	1,700	3,690
13	.....	.....	.....	.....	5,240	15,600	5,760	1,590	890	1,220	1,450	4,450
14	.....	.....	.....	.....	5,630	14,900	5,500	1,590	830	1,170	1,240	3,790
15	.....	.....	.....	.....	6,120	16,000	5,240	1,590	830	1,120	1,290	3,390
16	.....	.....	.....	.....	6,320	15,200	4,740	1,480	780	1,070	1,240	3,190
17	.....	.....	.....	.....	6,600	14,300	4,500	1,380	780	1,020	1,290	2,910
18	.....	.....	.....	.....	6,180	13,400	4,260	1,280	780	982	2,130	2,550
19	.....	.....	.....	.....	7,200	13,200	3,800	1,190	730	940	5,200	2,380
20	.....	.....	.....	.....	7,650	13,600	3,580	1,030	730	940	5,600	2,340
21	.....	.....	.....	.....	7,050	12,800	3,580	1,280	780	958	4,000	2,060
22	.....	.....	.....	.....	6,900	12,000	3,800	1,190	780	982	3,790	1,840
23	.....	.....	.....	.....	6,750	10,500	4,020	1,110	830	958	12,700	1,640
24	.....	.....	.....	.....	7,960	8,440	3,580	1,030	890	958	16,200	1,980
25	.....	.....	.....	.....	9,780	8,440	3,580	1,030	830	1,090	10,500	1,910
26	.....	.....	.....	5,500	12,000	8,120	3,380	1,590	780	1,040	9,140	1,840
27	.....	.....	.....	5,200	13,600	8,120	2,820	1,940	730	1,020	6,420	1,840
28	.....	.....	.....	5,110	12,800	7,800	3,000	1,590	780	970	7,420	1,840
29	.....	.....	.....	4,640	11,600	7,800	2,820	1,280	890	970	15,600	1,700
30	.....	.....	.....	4,380	9,780	7,800	2,820	1,280	1,380	982	20,800	1,740
31	.....	.....	.....	.....	9,780	.....	2,660	1,110	.....	994	.....	1,840

NOTE.—The daily discharges for July 27, 1904, to Oct. 12, 1909, are based on a fairly well-defined rating curve. Discharges interpolated for missing periods as follows:

Jan. 2 to 5, Sept. 29 to Oct. 19, Oct. 31 to Nov. 17, and Nov. 30, 1907, Mar. 17 to Apr. 6, 1908.

Water above the gage June 11 to 15, 1908, and discharge estimated as 18,000 second-feet per day.

Discharge estimated Aug. 29 to 31, 1908.

The daily discharges Apr. 26 to June 19, 1909, were obtained from the above rating curve by the aid of a gage height relation between the gage at the lower bridge and the records at Sherman Spur.

The daily discharges Oct. 13 to Dec. 31, 1909, were obtained from a rating curve well defined between 1,000 and 3,600 second-feet. Discharges Oct. 14 to 16, 1909, interpolated.

Monthly discharge of Wenatchee River at Cashmere, Wash., for 1904–1909.

[Drainage area, 1,250 square miles.] [a]

Month.	Discharge in second-feet.				Depth in inches on drainage area.	Total run-off in acre-feet.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.			
1904.							
July 27 to 31	4,260	3,180	3,780	3.02	0.56	37,500	C.
August	3,180	1,280	2,080	1.66	1.91	128,000	B.
September	1,480	830	1,080	.864	.96	64,300	B.
October	1,280	730	855	.684	.79	52,600	B.
November	1,940	690	1,100	.880	.98	65,500	B.
December	1,590	1,030	1,300	1.04	1.20	79,900	B.
The period	.....	.....	.....	.....	.....	428,000	
1905.							
January	1,110	730	900	.720	.83	55,300	B.
February	1,700	650	990	.792	.82	55,000	B.
March	6,040	1,820	4,370	3.50	4.04	269,000	B.
April	11,400	2,210	4,710	3.77	4.21	280,000	B.
May	11,600	4,740	6,550	5.24	6.04	403,000	B.
June	14,900	6,900	10,500	8.40	9.37	625,000	C.
July	7,200	2,500	4,450	3.56	4.10	274,000	B.
August	2,350	1,030	1,560	1.25	1.44	95,900	B.
September	1,820	890	1,090	.872	.97	64,900	B.
October	8,760	1,190	2,950	2.36	2.72	181,000	B.
November	1,940	1,190	1,400	1.12	1.25	83,300	B.
December	1,280	780	965	.772	.89	59,300	B.
The year	14,900	650	3,380	2.70	36.68	2,450,000	
1906.							
January	1,700	780	1,040	.832	1.96	64,000	B.
February	1,940	1,190	1,520	1.22	1.27	84,400	B.
March	3,180	1,190	1,450	1.16	1.34	89,200	B.
April	9,960	3,000	5,860	4.69	5.23	349,000	B.
May	11,600	4,740	7,860	6.29	7.25	483,000	B.
June	8,760	3,800	5,390	4.31	4.81	321,000	B.
July	6,320	1,590	3,260	2.61	3.01	200,000	B.
August	1,480	890	1,160	.928	1.07	71,300	B.
September	1,700	830	1,000	.800	.89	59,500	B.
October	12,400	830	2,420	1.94	2.24	149,000	B.
November 1–14	19,200	1,940	4,070	3.26	1.70	113,000	B.
December 27–31	1,480	1,380	1,420	1.14	.21	14,100	C.
The period	.....	.....	.....	.....	.....	2,000,000	
1907.							
January	1,380	890	1,040	.832	.959	64,000	B.
February	4,260	960	2,420	1.94	2.02	134,000	B.
March	2,660	1,280	2,040	1.63	1.88	125,000	B.
April	7,500	1,820	4,670	3.74	4.17	278,000	B.
May	18,500	6,320	12,500	10	11.50	769,000	C.
June	19,000	5,500	9,500	7.60	8.48	565,000	C.
July	6,600	2,500	4,330	3.46	3.99	266,000	B.
August	2,660	1,110	1,560	1.25	1.44	95,900	B.
September	1,700	890	1,220	.976	1.09	72,600	B.
October	1,110	1,110	1,110	.888	1.02	68,200	C.
November	2,500	1,120	1,300	1.04	1.16	77,400	C.
December	2,350	1,190	1,730	1.38	1.59	106,000	C.
The year	19,000	890	3,620	2.90	39.30	2,620,000	
1908.							
January	1,700	960	1,390	1.11	1.28	85,500	B.
February	1,480	890	1,210	.968	1.04	69,600	B.
March	3,580	1,380	2,380	1.91	2.20	146,000	C.
April	8,760	2,070	4,560	3.65	4.07	271,000	C.
May	9,780	5,760	8,050	6.44	7.42	495,000	C.
June	.....	6,320	11,500	9.20	10.26	684,000	C.
July	13,200	3,800	9,590	7.67	8.84	590,000	C.
August	3,800	.....	2,060	1.65	1.90	127,000	C.
The period	.....	.....	.....	.....	.....	2,470,000	

[a] The area of 1,190 square miles, formerly published, has been found by later measurements to be in error. The area given is correct for the old location below Mission Creek. After October 12, 1909, when station was moved above Mission Creek, the area is 1,200 square miles.

Monthly discharge of Wenatchee River at Cashmere, Wash., for 1904–1909—Continued.

Month.	Discharge in second-feet.				Depth in inches on drainage area.	Total run-off in acre-feet.	Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.			
1909.							
April 26-30	5,500	4.380	4,970	3.98	.74	49,300	B.
May	11,600	4.380	7,420	5.94	6.85	456,000	B.
June	21,400	7,800	13,600	10.9	12.16	809,000	B.
July	9,440	2,660	5,510	4.41	5.08	339,000	B.
August	1,940	1,030	1,510	1.21	1.40	92,800	B.
September	1,380	730	930	.744	.83	55,300	B.
October	1,480	940	1,090	*a* .900	*a* 1.04	67,000	B.
November	20,800	1,040	5,240	4.37	4.88	312,000	A.
December	17,100	1,640	4,030	3.36	3.87	248,000	A.
The period						2,430,000	

a The run-off per square mile for October is upon a basis of 1,200 square miles. The monthly total was reduced by the amount contributed by Mission Creek for period October 1-12.

CRAB CREEK DRAINAGE BASIN.

DESCRIPTION.

The streams of the large area of the Columbia Plains embraced in the great sweep of the river bounded on the north and west by the Columbia, on the south by Snake River, and on the east by the one hundred and eighteenth meridian, are insignificant. The only one that maintains a perennial flow along the greater portion of its channel is Crab Creek, which rises in the vicinity of Davenport, Wash., at an elevation of about 2,500 feet. The real channel of Crab Creek parallels the Great Northern Railway as far as Adrian. It then turns abruptly southward, flows through the easterly tier of sections in T. 21 and 22 N., R. 27 E., to about section 12 of T. 21, thence diagonally southeastward in a fairly straight course to the head of Parker Horn of Moses Lake. This portion of the stream may be designated as upper Crab Creek. Along the greater part of this stretch, above Wilson Creek, the surface flow is perennial, though the channel is at times dry from an unknown distance above Odessa to a point about 3 miles below, where the stream emerges from the gravels in considerable volume. The water sinks again below Wilson Creek, except for a few weeks during the spring high water. About 15 miles below the lake the stream again takes a westerly direction, flowing in a broad-bottomed, steep-walled canyon. At some point near the middle of this lower course Crab Creek sinks finally, and it delivers no surface water to the Columbia at the mouth of its canyon, except at times of freshets. This section of the stream below Moses Lake may be designated lower Crab Creek.

Crab Creek has only a few branches that contribute to its surface flow throughout the year and a few more that flow during the rainy

season, but it has a great number of deep tributary canyons, many of them scores of miles in length, which are dry except at periods of unusually heavy rainfall. These canyons, dry or containing only small streams disproportionate to their size, are known as coulees. They have all the topographic characters of stream-carved valleys, but evidently could not have been formed by stream erosion under present conditions. Their origin must be referred to a prehistoric period in which the region had an abundant rainfall and was well watered by surface streams. These branching systems of dry canyons represent ancient river systems.

The most important of the branches of the ancient Crab Creek system, except Grand Coulee, is Lind Coulee, in which the Northern Pacific Railway runs from Providence to Ritzville.

Providence Coulee, in which Hatton, Scott, and Connell are situated, is now devoid of flowing water, though it once formed the trunk of a river system almost as large as that for which Crab Creek is the master stream.

Of all the abandoned canyons of the Columbia Plains, however, the greatest and most remarkable is Grand Coulee. Not only does it possess many features of scenic grandeur, but its geologic history is of the highest interest. This great chasm was carved by Columbia River at a time when its profound gorge was dammed by a great ice lobe that came down the valley of the Okanogan and pushed southward some 30 miles across the plateau south of the master stream. The waters of the Columbia, deflected by the great glacier, flowed along its eastern face, and continuing southward in what is now the bed of Crab Creek regained their proper channel just above Sentinel Bluffs.

Lakes, generally small and shallow and invariably situated in coulees, are numerous in the northern portion of the region. Their basins were formed by the erosion of former streams or dammed by wind-blown materials, and they are therefore usually elongated in form and separated by stretches of dry or meadowy land. The most important series of lakes in this region is that which lies in the bottom of the Grand Coulee and which includes Moses Lake, the largest sheet of water in the Columbia Plains.

Most of the lakes in this arid region have no outlets; others overflow only in the rainy season; as a consequence the small amounts of salts contained in all surface waters are concentrated in the lake basins by evaporation, and most of the lakes are more or less alkaline, Moses Lake containing about 0.32 gram of total solids per liter of water.[1]

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[1] Ann. Rept. Geol. Survey Washington, vol. 1, 1901, p. 294.

The lakes in the lower section of the Grand Coulee are successively higher from south to north, and the northern lakes occasionally overflow to the south at seasons of high water. It follows that while the water of the northernmost of these lakes is comparatively fresh and palatable, the waters of the others become successively more alkaline to the south, those of Soap Lake, the most southerly, being extremely alkaline.

The annual rainfall in this area is from 10 to 20 inches, most of which falls during the winter months. On the higher lands, which receive more rainfall than the valley lands, great quantities of wheat are grown; on the lower lands successful agriculture is not possible without irrigation. Some development by pumping from Moses Lake and from wells has proved fairly successful. About 1,000 acres of land between Adrian and Ephrata are irrigated by a gravity system that takes water from Upper Crab Creek.

UPPER CRAB CREEK NEAR EPHRATA, WASH.

This station, which was established June 21, 1909, is located at Drumheller's ranch, 8 miles southeast of Ephrata, in the SE. ¼ sec. 5, T. 20 N., R. 27 E. It is maintained in cooperation with Ham, Yearsley & Ryrie, of Spokane. The data obtained are of value in connection with the development of irrigation by storage in Moses Lake.

The gage is a vertical staff on the right bank of the stream at a private bridge 500 feet south of Drumheller's house. Measurements are made from the bridge. The bed of the stream is of hard clay and not liable to change.

The waters in this stream are supplied entirely from copious springs about 6 miles above the station.

Discharge measurements of Upper Crab Creek near Ephrata, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 21	Howard Kimble	18	77.8	4.88	89.1
Aug. 18	J. C. Stevens	16	76	4.76	80

Daily gage height, in feet, of Upper Crab Creek near Ephrata, Wash., for 1909.

[T. R. Stevens, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.80	4.83	4.75	4.68	4.45	16	.....	4.83	4.83	4.70	4.62	4.43
2	.....	4.85	4.85	4.78	4.68	4.45	17	.....	4.80	4.82	4.70	4.55	4.48
3	.....	4.85	4.85	4.78	4.65	4.43	18	.....	4.83	4.76	4.70	4.55	4.48
4	.....	4.83	4.85	4.73	4.65	4.48	19	.....	4.82	4.75	4.72	4.53	4.48
5	.....	4.83	4.85	4.73	4.65	4.48	20	.....	4.83	4.73	4.72	4.52	4.48
6	.....	4.80	4.83	4.73	4.65	4.48	21	4.85	4.85	4.73	4.70	4.50	4.48
7	.....	4.90	4.80	4.72	4.65	4.48	22	4.85	4.85	4.75	4.72	4.50	4.48
8	.....	4.90	4.80	4.72	4.65	4.48	23	4.85	4.85	4.75	4.72	4.50	4.45
9	.....	4.95	4.83	4.73	4.65	4.48	24	4.80	4.85	4.75	4.72	4.50	4.45
10	.....	4.95	4.85	4.70	4.62	4.48	25	4.80	4.80	4.70	4.70	4.50	4.45
11	.....	4.85	4.80	4.70	4.63	4.48	26	4.80	4.80	4.73	4.70	4.50	4.45
12	.....	4.85	4.85	4.70	4.60	4.55	27	4.80	4.80	4.74	4.70	4.50	4.45
13	.....	4.90	4.85	4.73	4.60	4.55	28	4.80	4.80	4.74	4.68	4.45	4.43
14	.....	4.90	4.83	4.73	4.60	4.43	29	4.80	4.90	4.73	4.68	4.45	4.43
15	.....	4.90	4.80	4.73	4.60	4.43	30	4.80	4.90	4.75	4.68	4.45	4.43
							31	.....	4.83	4.75	.....	4.45	.....

Daily discharge, in second-feet, of Upper Crab Creek near Ephrata, Wash., for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	83	85	79	74	58	16	.....	85	85	75	69	57
2	.....	87	87	81	74	58	17	.....	83	85	75	64	60
3	.....	87	87	81	72	57	18	.....	85	80	75	64	60
4	.....	85	87	77	72	60	19	.....	85	79	77	63	60
5	.....	85	87	77	72	60	20	.....	85	77	77	62	60
6	.....	83	85	77	72	60	21	87	87	77	75	61	60
7	.....	91	83	77	72	60	22	87	87	79	77	61	60
8	.....	91	83	77	72	60	23	87	87	79	77	61	58
9	.....	95	85	77	72	60	24	83	87	79	77	61	58
10	.....	95	87	75	69	60	25	83	83	75	75	61	58
11	.....	87	83	75	70	60	26	83	83	77	75	61	58
12	.....	87	87	75	68	64	27	83	83	78	75	61	58
13	.....	91	87	77	68	64	28	83	83	78	74	58	57
14	.....	91	85	77	68	57	29	83	91	77	74	58	57
15	.....	91	83	77	68	57	30	83	91	79	74	58	57
							31	.....	85	79	.....	58	.....

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Upper Crab Creek near Ephrata, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June (21–30)	87	83	84.2	1,670	B.
July	95	83	87.1	5,360	B.
August	87	75	82.1	5,050	B.
September	81	74	76.4	4,550	B.
October	74	58	65.9	4,050	B.
November	64	57	59.1	3,520	B.
December	.....	.....	[a] 56	3,440	.....
The period	.....	.....	.....	27,600	

[a] Estimated on basis of discharge on Jan. 1, 1910.

MOSES LAKE AT MOSES LAKE, WASH.

The lake gage was established in the Parker Horn of Moses Lake June 23, 1909. The gage is located 1 mile west of Moses Lake post office, on the east shore of Moses Lake near the center of sec. 28, T. 19 N., R. 28 E. The gage was established in connection with the evaporation station at this point.

Heights obtained here are used in the study of the available storage in Moses Lake, the waters of which will be used to irrigate lands on the south side of Frenchman Hill.

The evaporation pan is of galvanized iron, 3 feet square and 2 feet deep, inclosed by a boom of logs. In the center of the pan is a needle point to which the water is adjusted at the time of observations. The observer is supplied with a cup which holds sufficient water to increase the depth in the pan one-tenth of an inch. In this manner the number of cupfuls added at each observation is readily reduced to inches of evaporation. There is also a rain gage at Moses Lake post office.

Daily gage height, in feet, of Moses Lake at Moses Lake, Wash., for 1909.

[Fanlay Imbert, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			4.11					16							
2								17					3.82		
3					3.84			18		4.12	3.75				
4		4.22						19				3.78			
5				3.72			[a] 3.70	20							
6								21							
7						4.11		22			3.75				
8			3.80					23							
9								24					3.92		
10					3.75			25		4.10					
11		4.25						26				3.80			
12							[a] 3.75	27	4.22						
13				3.72				28						3.70	
14						4.11		29			3.72				
15			3.80					30							
								31					4.02		

[a] Lake frozen over.

Evaporation from Moses Lake at Moses Lake, Wash., for 1909.

Month.	Evaporation.	Mean temperature (°F.).	
		Water in pan.	Water in lake.
	Inches.		
July	7.20	69	66
August	6.63	70	70
September	4.14	68	68
October	.76	55	55
The period	18.73	65	65

NOTE.—There was no precipitation during this period.

LOWER CRAB CREEK NEAR WARDEN, WASH.

This station, which was established June 23, 1909, is located on the McManaman ranch, 12 miles west of Warden, in the SW. ¼ sec. 24, T. 17 N., R. 28 E. The data obtained here are used in connection with the proposed project for the storage of water in Moses Lake for the irrigation of lands south of Frenchman Hill.

The gage is a vertical staff driven in the bed of the stream on the left bank. Measurements are made by wading. The banks of the stream are low and subject to overflow. The bed is composed of shifting sand. During the summer months the water is supplied by seepage from Moses Lake and from several springs in the vicinity. The largest spring, that on the lower Drumheller ranch, probably discharges 15 to 20 second-feet.

Discharge measurements of Lower Crab Creek near Warden, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 23	Howard Kimble	33	28.5	2.53	74.9
Aug. 17	J. C. Stevens	27	13.2	1.55	34.1

Daily gage height, in feet, of Lower Crab Creek near Warden, Wash., for 1909.

[James McManaman, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.30	1.74	1.50	1.46	1.50	1.40	16	.....	1.70	1.59	1.33	.....	1.55	1.40
2	.....	2.20	1.73	1.53	1.40	1.50	1.40	17	.....	1.69	1.56	1.34	.....	1.50	1.40
3	.....	2.14	1.75	1.44	1.44	1.46	1.50	18	.....	1.71	1.59	1.34	.....	1.70	1.50
4	.....	2.16	1.76	1.43	.....	1.48	1.80	19	.....	1.72	1.58	1.38	.....	1.60	1.50
5	.....	2.14	1.77	1.47	.....	1.46	2.00	20	.....	1.69	1.57	1.40	.....	1.60	2.10
6	.....	2.15	1.70	1.40	.....	1.45	2.10	21	.....	1.71	1.56	1.38	.....	1.50	1.70
7	.....	2.18	1.69	1.45	.....	.....	2.40	22	.....	1.72	1.58	1.42	.....	1.70	2.00
8	.....	2.25	1.69	1.47	.....	.....	2.60	23	2.53	1.69	1.57	1.42	.....	1.50	2.30
9	.....	2.19	1.68	1.50	.....	.....	2.20	24	.....	1.70	1.59	1.46	.....	1.40	2.90
10	.....	2.18	1.67	1.40	.....	.....	1.80	25	.....	1.73	1.60	1.43	.....	1.50	2.80
11	.....	2.00	1.65	1.30	.....	.....	1.60	26	.....	1.74	1.62	1.45	.....	1.40	2.80
12	.....	1.88	1.63	1.33	.....	.....	1.50	27	2.46	1.76	1.60	1.44	.....	1.40	2.70
13	.....	1.82	1.50	1.31	.....	.....	1.40	28	2.45	1.75	1.60	1.48	.....	1.50	1.80
14	.....	1.81	1.62	1.34	.....	.....	2.10	29	2.43	1.77	1.57	1.49	.....	1.50	1.70
15	.....	1.75	1.60	1.30	.....	1.60	1.40	30	2.35	1.77	1.56	1.48	.....	1.40	1.50
								31	.....	1.70	1.50	.....	1.47	.....	1.40

NOTE.—Ice conditions Dec. 4 to 10, 14, 20, and 23 to 27.

Daily discharge, in second-feet, of Lower Crab Creek near Warden, Wash., for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	64	42	32	31	32	29	16	.....	40	36	27	30	34	29
2	.....	60	41	33	29	32	29	17	.....	40	34	27	30	32	29
3	.....	58	42	30	30	31	32	18	.....	40	36	27	30	40	32
4	.....	58	42	30	30	31	44	19	.....	41	35	28	30	36	32
5	.....	58	43	31	30	31	36	20	.....	40	35	29	30	36	36
6	.....	58	40	29	30	30	39	21	.....	40	34	28	30	32	40
7	.....	59	40	30	30	31	48	22	.....	41	35	30	30	40	52
8	.....	62	40	31	30	31	55	23	76	40	35	30	30	32	51
9	.....	60	39	32	30	32	42	24	75	40	36	31	30	29	49
10	.....	59	39	29	30	33	44	25	74	41	36	30	30	32	48
11	.....	52	38	26	30	33	36	26	73	42	37	30	30	29	47
12	.....	47	37	27	30	34	32	27	72	42	36	30	30	29	45
13	.....	45	32	26	30	35	29	28	72	42	36	31	30	32	44
14	.....	44	37	27	30	35	29	29	70	43	35	32	30	32	40
15	.....	42	36	26	30	36	29	30	66	43	34	31	30	29	32
								31	.....	40	32	.....	31	.....	29

NOTE.—These discharges are based on a rating curve that is fairly well defined. Ice conditions December 4 to 10, 14, 20, and 23 to 27. Discharges June 23 to 30, December 14, 20, and 23 to 27 interpolated. Discharges October 4 to 30, June 24 to 26, and November 7 to 14 estimated.

Monthly discharge of Lower Crab Creek near Warden, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June (23 to 30)	76	66	72.2	1,150	B.
July	64	40	47.8	2,940	B.
August	43	32	37.1	2,280	B.
September	33	26	29.3	1,740	C.
October	31	29	[a] 30.0	1,840	C.
November	40	29	[a] 32.7	1,950	C.
December	.....	.....	[a] 37.4	2,300	D.
The period	.....	.....	.....	14,200	

[a] Partly estimated.

YAKIMA RIVER DRAINAGE BASIN.

DESCRIPTION.

Yakima River rises in Keechelus Lake, in the northwestern part of Kittitas County, and flows southeastward for about 150 miles to its junction with the Columbia, 8 miles northwest of Pasco and 4 miles above the mouth of Snake River. Its drainage area, comprising 5,270 square miles, extends southward from the Wenatchee Mountains and includes a stretch of nearly 100 miles along the eastern slope of the Cascade Range. It has many tributaries, the most important coming from the west, as is shown by the following table:

Principal tributaries of Yakima River.

From the south and west:
Big Creek.
Taneum Creek.
Manastash Creek.
Wenas Creek.
Naches River (draining about 50 miles of Cascade Range).
Tieton River.
Cowiche Creek.
Atanum Creek (forming northern boundary of Yakima Indian Reservation).
Toppenish Creek (draining Yakima Indian Reservation).
Satus Creek.

From the north and east:
Kachess River (Kachess Lake).
Clealum River (Clealum Lake).
Teanaway Creek.
Swauk Creek.
Wilson Creek.
Cherry Creek
Selah Creek.

The country at the headwaters of these streams is densely forested and mountainous. The general elevation of the summit of that portion of the Cascade Mountains drained by them is 5,500 feet above sea level. Keechelus Lake is 2,458 feet above sea level, Kachess Lake 2,230, Clealum Lake 2,130, Ellensburg 1,545, North Yakima 1,090, and Kiona 515 feet.

The agricultural lands of this basin lie in four distinct valleys. The upper, beginning just below the mouth of Swauk Creek and known as the Kittitas Valley, is somewhat oval in shape, about 30 miles long and 16 miles wide. Ellensburg is its chief city. Below Kittitas Valley the river flows in a narrow canyon, from which it emerges into Selah Valley. From Selah Valley it passes through a narrow gap into Yakima and Moxee valleys. Below Moxee Valley the river has cut its way through the Atanum and Rattlesnake ridges, forming a short narrow canyon, known as Union Gap. Below Union Gap the river flows to its mouth through a wide valley, unbroken except for the Toppenish Ridge, which lies south of the river, approximately at right angles to its course.

The mean annual rainfall at Clealum is 28 inches, at Ellensburg 10 inches, at North Yakima 9 inches, and at Sunnyside 7 inches. The greater part of the precipitation occurs in the winter as snow. The snowfall near the summit of the Cascade Range frequently aggregates 25 or 30 feet in one season.

Irrigation has been practiced in this valley for many years, and ditches of all sizes—from the small ditch watering a few acres on the banks of the creeks to large canals that extend for 60 miles and cover 40,000 or 50,000 acres of land—have been in successful operation for a number of years. The products cover the entire range of irrigated agriculture, from hay and grain in the upper portion of the valley to the fancy fruits raised throughout the lower portions of

the basin. Irrigated orchards in the vicinity of North Yakima have attained a value of $1,000 to $3,000 an acre.

The United States Reclamation Service has undertaken the general development of this valley. The principal storage reservoirs are Keechelus, Kachess, Clealum, and Bumping lakes, and at McAllister Meadows on Tieton River. The development of the projects will be made in several units. The first was started by the purchase of the Sunnyside canal, which diverts water from Yakima River below Union Gap. The second unit is the Tieton project, which diverts water from Tieton River for the benefit of land to the west of North Yakima. As Tieton Rvier is the principal tributary of the Naches, whose natural flow has been entirely appropriated for irrigation through private enterprises, the water to be taken from the Tieton will be replaced by the release of water from the Bumping Lake Reservoir. Other units are the Wapato project, which contemplates the enlargement and extension of two canals built by the United States Indian Office and the development of small storage reservoirs on the headwaters of Toppenish Creek and Kittitas unit for the irrigation of lands in Kittitas Valley.

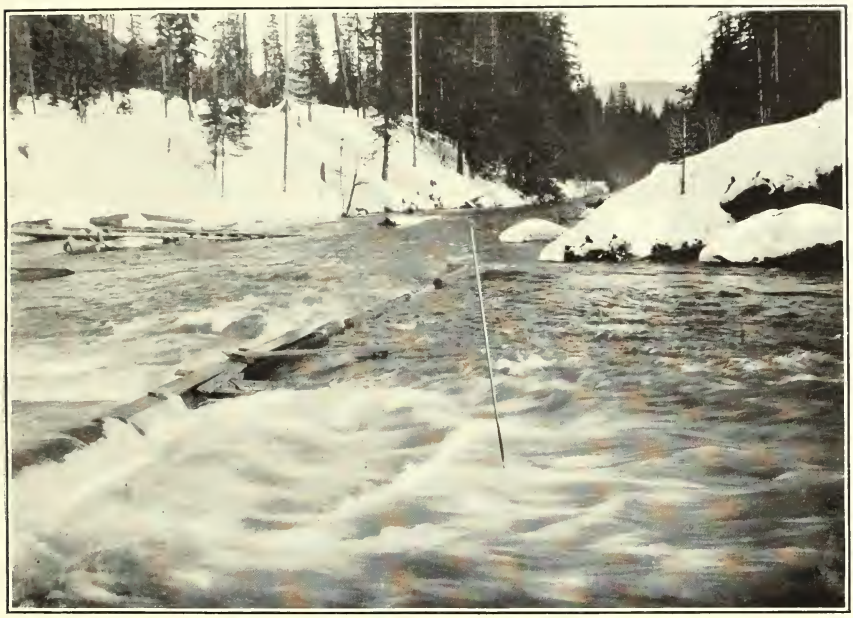
The intensive agriculture of this valley has rendered necessary the development of water powers. Several water-power plants are in successful operation, the largest being the plant of the Wapatox Co. Water is taken from Naches River in a long canal and used both for water power and irrigation.

Records of stream flow have been maintained in this valley since 1893. The year 1905 was the driest year since records have been obtained; 1903 was a wet year.

KEECHELUS LAKE NEAR MARTIN, WASH.

A gage was established in Keechelus Lake January 12, 1906. It is just above the outlet of the lake, 4 miles northwest of Martin, Wash., on the State road over Snoqualmie Pass.

The gage as originally established was 300 feet from the outlet of the lake at an arbitrary datum. When the dam at the outlet was completed in the winter of 1906–7, the gage was moved, and now indicates the height above the sill of the outlet tunnels in the dam. All records have been corrected to this latter datum, which is 2,457 feet above sea level. (See Pl. V.)



A. VIEW LOOKING DOWNSTREAM FROM DAM AT OUTLET.

B. CRIB DAM AT OUTLET

KEECHELUS LAKE, WASHINGTON.

Daily gage height, in feet, of Keechelus Lake near Martin, Wash., for 1909.

[Christian Hansen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.46	11.36	11.33	11.52	11.76	12.84	11.84	11.24	5.95	2.30	2.30	12.72
2	11.45	11.34	11.32	11.51	11.79	13.00	11.86	11.22	5.65	2.25	3.80	12.20
3	11.47	11.33	11.30	11.48	11.99	12.85	11.90	11.20	5.35	2.20	6.85	11.98
4	11.50	11.31	11.30	11.46	12.32	12.66	11.88	11.20	5.05	2.20	8.20	11.84
5	11.46	11.32	11.28	11.44	12.25	12.53	11.84	11.20	4.75	2.20	8.88	11.76
6	11.45	11.35	11.26	11.44	12.06	12.42	11.81	11.19	4.45	2.20	8.79	11.65
7	11.44	11.34	11.24	11.40	11.92	12.35	11.78	11.19	4.05	2.30	8.80	11.61
8	11.43	11.34	11.29	11.40	11.83	12.34	11.74	11.17	3.75	2.30	8.84	11.58
9	11.40	11.33	11.30	11.42	11.82	12.38	11.72	11.17	3.45	2.30	7.30	11.55
10	11.38	11.32	11.26	11.44	11.82	12.49	11.68	11.16	3.25	2.30	6.84	11.54
11	11.35	11.30	11.25	11.46	11.78	12.58	11.74	11.16	3.05	2.30	6.38	11.52
12	11.34	11.28	11.24	11.50	11.74	12.57	11.72	11.15	2.85	2.30	5.95	11.90
13	11.34	11.28	11.25	11.56	11.72	12.43	11.62	11.15	2.70	2.30	5.65	12.22
14	11.34	11.27	11.26	11.60	11.70	12.31	11.57	11.06	2.60	2.20	5.60	12.08
15	11.33	11.30	11.28	11.60	11.69	12.34	11.55	10.91	2.50	2.20	5.62	11.88
16	11.32	11.34	11.30	11.58	11.71	12.30	11.51	10.82	2.40	2.20	5.85	11.72
17	11.37	11.44	11.33	11.54	11.74	12.20	11.47	10.66	2.35	2.10	6.05	11.59
18	11.39	11.50	11.30	11.52	11.76	12.14	11.47	10.48	2.20	2.10	7.10	11.55
19	11.48	11.46	11.29	11.50	11.80	12.13	11.46	10.38	2.10	2.10	10.65	11.53
20	11.59	11.43	11.28	11.51	11.81	12.09	11.43	9.78	2.20	2.10	12.15	11.51
21	11.69	11.38	11.27	11.50	11.77	12.04	11.40	9.26	2.50	2.10	12.25	11.47
22	11.64	11.36	11.30	11.52	11.75	11.98	11.42	8.74	2.50	2.10	12.42	11.44
23	11.56	11.35	11.30	11.54	11.75	11.96	11.39	8.32	2.50	2.10	14.38	11.44
24	11.51	11.34	11.32	11.55	11.84	11.91	11.38	7.96	2.45	2.10	14.14	11.42
25	11.46	11.35	11.34	11.65	12.01	11.88	11.37	7.68	2.40	2.10	12.92	11.42
26	11.43	11.33	11.37	12.00	12.26	11.88	11.32	7.38	2.40	2.10	12.38	11.40
27	11.40	11.34	11.39	12.11	12.45	11.86	11.31	7.04	2.30	2.10	12.07	11.38
28	11.38	11.33	11.41	12.09	12.44	11.85	11.30	6.76	2.30	2.10	12.15	11.38
29	11.38	.....	11.48	11.90	12.38	11.83	11.30	6.56	2.30	2.10	13.23	11.37
30	11.38	.....	11.50	11.81	12.32	11.86	11.28	6.42	2.30	2.10	13.45	11.36
31	11.37	.....	11.52	.....	12.42	.....	11.27	6.25	.....	2.20	.....	11.36

Table showing volume of storage on Keechelus Lake near Martin, Wash., for 1909.

Gage height.	Storage.	Gage height.	Storage.	Gage height.	Storage.
Feet.	*Acre-feet.*	*Feet.*	*Acre-feet.*	*Feet.*	*Acre-feet.*
0.00	0	5.00	7,100	10.00	14,500
1.00	1,400	6.00	8,550	11.00	16,000
2.00	2,800	7.00	10,000	12.00	17,500
3.00	4,200	8.00	11,500	13.00	19,050
4.00	5,650	9.00	13,000	14.00	20,600

NOTE.—This table has been used to determine the amount of water stored in or drawn from the lake and in connection with the records on Yakima River near Martin to compute the inflow into the lake.

This table differs slightly from that published in Water-Supply Paper 252. It is the same as is now used by the United States Reclamation Service.

YAKIMA RIVER NEAR MARTIN, WASH.

This station, which was established October 18, 1903, is located at the outlet of Keechelus Lake, 4 miles northwest of Martin station, on the Northern Pacific Railway.

The data are used by the United States Reclamation Service in their general studies for the reclamation of lands in the Yakima River valley. Keechelus Lake is at present used as a storage reservoir. A temporary timber dam has been constructed, which will be replaced by a permanent dam high enough to fully develop the storage capacity of this area.

On November 14, 1903, the staff gage was destroyed and records were discontinued until January 28, 1904, when a new vertical staff was installed 75 feet above the old location at a new datum, 2,448.76 feet above sea level. The datum of this gage has remained unchanged. All gage heights in 1903 were reduced to the datum of the new gage. The new gage is about 1,000 feet below the outlet of the lake and about 800 feet below the dam. Discharge measurements are made from a cable at the gage.

The conditions at the station are favorable for obtaining good results. During the winter months, although the lake freezes, the flow at the station is under open-channel conditions on account of the rapid velocities which obtain.

Discharge measurements of Yakima River near Martin, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 5	H. D. McGlashan	121	374	8.80	1,250
July 22	Howard Kimble	108	177	6.90	250
Sept. 16	C. F. Gleason	107	131	6.61	123
Oct. 5	Howard Kimble	105	137	6.53	123
Nov. 6	do	118	329	8.35	893

Daily gage height, in second-feet, of Yakima River near Martin, Wash., for 1909.

[Christian Hansen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.80	6.70	6.66	7.04	7.52	9.40	7.64	6.64	7.25	6.60	6.59	9.22
2	6.78	6.68	6.65	7.02	7.58	9.64	7.66	6.57	7.26	6.58	7.25	8.38
3	6.94	6.65	6.60	6.98	7.93	9.43	7.71	6.54	7.25	6.58	8.25	7.86
4	7.06	6.64	6.58	6.96	8.62	9.08	7.67	6.53	7.26	6.56	8.42	7.56
5	7.00	6.65	6.58	6.92	8.46	8.80	7.59	6.52	7.25	6.56	8.44	7.42
6	6.98	6.70	6.54	6.93	8.12	8.63	7.49	6.48	7.24	6.57	8.32	7.28
7	6.94	6.68	6.50	6.86	7.89	8.53	7.47	6.46	7.22	6.58	8.20	7.16
8	6.90	6.66	6.58	6.84	7.75	8.48	7.44	6.44	7.20	6.58	8.23	7.12
9	6.79	6.65	6.60	6.96	7.72	8.59	7.42	6.42	7.08	6.58	8.18	7.12
10	6.76	6.62	6.56	6.94	7.71	8.69	7.36	6.41	6.99	6.59	8.08	7.10
11	6.74	6.60	6.52	6.98	7.66	8.82	7.43	6.40	6.91	6.58	7.96	7.10
12	6.64	6.58	6.53	7.00	7.56	8.79	7.42	6.39	6.83	6.58	7.83	7.72
13	6.63	6.58	6.50	7.09	7.50	8.48	7.30	6.38	6.76	6.58	7.72	8.40
14	6.61	6.56	6.54	7.18	7.50	8.34	7.22	6.98	6.71	6.55	6.75	8.22
15	6.60	6.60	6.54	7.19	7.49	8.42	7.19	6.84	6.65	6.54	6.15	8.08
16	6.62	6.80	6.58	7.15	7.51	8.39	7.13	6.86	6.61	6.54	5.50	7.85
17	6.78	6.91	6.66	7.10	7.56	8.26	7.08	6.86	6.59	6.53	6.20	7.45
18	6.82	7.03	6.64	7.06	7.63	8.17	7.04	6.86	6.54	6.52	6.25	7.11
19	7.00	6.97	6.58	7.02	7.71	8.16	6.98	6.85	6.52	6.50	6.55	7.04
20	7.16	6.88	6.56	7.03	7.72	8.10	6.92	7.85	6.56	6.49	8.32	6.91
21	7.34	6.81	6.56	7.02	7.64	8.01	6.88	7.85	6.67	6.48	8.30	6.90
22	7.24	6.74	6.59	7.05	7.60	7.92	6.90	7.68	6.69	6.49	8.74	6.88
23	7.08	6.70	6.60	7.09	7.84	7.88	6.87	7.35	6.68	6.49	12.26	6.87
24	7.02	6.68	6.66	7.11	7.60	7.80	6.86	7.34	6.66	6.50	11.84	6.86
25	6.96	6.70	6.67	7.27	8.06	7.71	6.84	7.35	6.66	6.51	9.50	6.84
26	6.89	6.68	6.78	7.68	8.50	7.72	6.76	7.35	6.64	6.50	8.58	6.81
27	6.86	6.68	6.82	7.83	8.80	7.67	6.74	7.34	6.62	6.50	8.06	6.80
28	6.80	6.65	6.86	7.96	8.74	7.63	6.70	6.89	6.60	6.49	8.23	6.78
29	6.77	.....	6.94	7.78	8.59	7.58	6.70	6.85	6.61	6.50	9.98	6.78
30	6.74	.....	7.00	7.62	8.49	7.62	6.68	6.86	6.62	6.52	10.80	6.76
31	6.72	.....	7.05	.....	8.69	.....	6.64	7.05	.....	6.55	.....	6.75

Daily discharge, in second-feet, of Yakima River near Martin, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	186	158	148	258	439	1,740	492	144	331	134	132	1,580
2	180	153	146	251	465	1,940	502	127	335	130	331	914
3	227	146	134	239	634	1,760	525	121	335	130	825	598
4	264	144	130	233	1,090	1,470	506	119	335	125	942	456
5	245	146	130	221	971	1,230	470	116	331	125	957	398
6	239	158	121	224	742	1,100	426	108	327	127	872	342
7	227	153	112	203	613	1,020	418	104	320	130	792	298
8	215	148	130	198	544	986	406	101	312	130	812	284
9	183	146	134	203	529	1,070	398	97	271	130	780	284
10	175	139	125	227	525	1,150	374	95	242	132	718	277
11	169	134	116	237	502	1,250	402	93	218	130	650	277
12	144	130	119	245	456	1,230	398	91	195	130	582	529
13	141	130	112	274	430	986	350	90	175	130	529	928
14	136	125	121	305	430	886	320	239	161	123	172	805
15	134	134	121	308	426	942	308	198	146	121	56	718
16	139	186	130	294	434	921	288	203	136	121	0	592
17	180	218	148	277	456	832	271	203	132	119	62	410
18	192	255	144	264	488	773	258	203	121	116	69	280
19	245	236	130	251	525	767	239	200	116	112	123	258
20	298	209	125	255	529	730	221	592	125	110	872	218
21	366	189	125	251	492	678	209	592	151	108	858	215
22	327	169	132	261	474	629	215	511	156	110	1,190	209
23	271	158	134	274	587	608	206	370	153	110	4,370	206
24	251	153	148	280	474	567	203	366	148	112	3,940	203
25	233	158	151	339	707	525	198	370	148	114	1,820	198
26	212	153	180	511	1,000	529	175	370	144	112	1,060	189
27	203	153	192	582	1,230	506	169	366	139	112	707	186
28	186	146	203	650	1,190	488	158	212	134	110	812	180
29	178	.....	227	558	1,070	465	158	200	136	112	2,220	180
30	169	.....	245	483	993	483	153	203	139	116	2,950	175
31	164	.....	261	.....	1,150	.....	144	261	.....	123	.....	172

NOTE.—These discharges are based on a rating curve that is well defined.

Monthly discharge of Yakima River near Martin, Wash., for 1909.

[Drainage area, 56 square miles.]

Month.	Observed discharge in second-feet.			Run-off in acre-feet.			Discharge without storage in second-feet.		Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	Mean.	Mean per square mile.		
January	366	134	209	12,900	− 135	12,800	208	3.71	4.28	A.
February	255	125	162	9,000	− 60	8,940	161	2.88	3.00	A.
March	261	112	148	9,100	+ 285	9,380	153	2.73	3.15	A.
April	650	198	305	18,100	+ 435	18,500	311	5.53	6.19	A.
May	1,230	426	664	40,800	+ 936	41,700	678	12.1	13.95	A.
June	1,940	465	942	56,100	− 861	55,200	927	16.6	18.52	A.
July	525	144	308	18,900	− 885	18,000	293	5.23	6.03	B.
August	592	90	228	14,000	− 7,490	6,510	106	1.89	2.18	A.
September	335	116	204	12,100	− 5,690	6,410	108	1.93	2.15	A.
October	134	108	121	7,440	− 140	7,300	118	2.11	2.43	B.
November	4,370	0	1,010	60,100	+16,700	76,800	1,290	23.0	25.66	A.
December	1,580	172	405	24,900	− 3,210	21,700	353	6.30	7.26	A.
The year	4,370	0	392	283,000	.....	283,000	392	7.00	94.80	

YAKIMA RIVER AT CLEALUM, WASH.

The station, which is located at the highway bridge just above the town of Clealum, Wash., 6 miles above the mouth of Teanaway River and 3 miles below the mouth of Clealum River, was established August 26, 1906, to obtain data to be used in determining the most economic method of operating the storage reservoirs contemplated and under construction on the headwaters by the United States Reclamation Service. The records also show the combined flow of the three rivers forming the headwaters of Yakima River.

A chain gage is installed on the highway bridge, from which discharge measurements are made. The flood of November, 1906, partly destroyed the bridge and the gage equipment. The datum was maintained, although the channel conditions were so altered that another rating was required. Since that date the conditions have been more favorable for good results than they were before, and the data are reliable. On November 7, 1909, it was found that the gage datum had lowered 0.27 foot, by the settling of the bridge. No corrections were made to the gage heights, as it was impossible to determine when the settling occurred. Sufficient measurements were made in 1909 to define a rating curve for the changed datum.

Ice affects the gage heights for a short period during the winter months. At such times, and where other means fail, the data are usually supplied by interpolation.

Discharge measurements of Yakima River at Clealum, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 20	L. R. Allen	198	581	2.65	882
Apr. 2	H. D. McGlashan	207	749	3.49	1,600
May 13	J. C. Stevens	215	978	4.53	3,020
June 3	H. D. McGlashan	247	1,600	7.27	9,590
July 24	H. Kimble	196	618	3.23	1,280
24	Gleason and Kimble	196	603	3.21	1,370
Sept. 17	C. F. Gleason	186	384	2.06	483
Oct. 4	H. Kimble	186	405	2.18	554
Nov. 4	.....do	220	1,050	4.90	3,780
24	.....do	399	2,520	10.00	19,200
Dec. 17	.....do	215	923	4.26	2,480

Daily gage height, in feet, of Yakima River at Clealum, Wash., for 1909.

[F. J. Denny, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.42	2.25	2.32	3.58	4.45	6.20	4.28	3.08	2.70	2.22	2.08	8.21
2	2.40	2.20	2.38	3.50	4.50	7.10	4.30	3.08	2.78	2.22	2.38	6.98
3	2.40	2.20	2.30	3.42	4.82	7.30	4.33	3.08	2.75	2.18	4.38	6.10
4	2.45	2.18	2.30	3.38	4.52	6.92	4.35	3.07	2.72	2.15	4.90	5.48
5	2.48	2.18	2.25	3.30	5.75	6.52	4.30	3.07	2.69	2.14	4.82	5.09
6	2.70	2.18	2.20	3.30	5.38	6.28	4.25	3.06	2.68	2.11	4.70	4.82
7	2.70	2.20	2.18	3.25	5.00	6.00	4.12	2.98	2.60	2.17	4.54	4.60
8	2.60	2.15	2.22	3.20	4.80	5.88	3.98	2.94	2.58	2.19	4.44	4.41
9	2.45	2.10	2.28	3.22	4.70	5.88	3.88	2.95	2.55	2.18	4.41	4.28
10	2.40	2.10	2.25	3.35	4.72	5.94	3.78	2.95	2.48	2.17	4.30	4.12

Daily gage height, in feet, of Yakima River at Clealum, Wash., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2.45	2.10	2.22	3.50	4.68	6.10	3.75	2.92	2.38	2.16	4.24	4.08
12	2.32	2.08	2.22	3.60	4.52	6.15	3.80	2.95	2.32	2.18	4.15	4.18
13	2.25	2.08	2.32	3.75	4.55	6.00	3.78	2.98	2.22	2.16	4.05	4.95
14	2.45	2.08	2.42	4.00	4.68	5.70	3.65	2.90	2.15	2.14	4.35	4.94
15	2.48	2.05	2.48	4.05	4.82	5.65	3.52	3.08	2.10	2.12	4.05	4.70
16	2.40	2.15	2.55	4.00	4.88	5.72	3.42	2.98	2.08	2.08	3.58	4.47
17	2.38	2.35	2.62	3.90	4.85	5.55	3.38	2.95	2.05	2.07	3.30	4.28
18	2.40	2.52	2.72	3.85	4.90	5.35	3.28	3.00	2.04	2.05	3.34	4.10
19	2.42	2.60	2.72	3.78	4.98	5.15	3.18	2.98	2.02	2.02	4.18	3.97
20	2.60	2.55	2.75	3.78	5.02	5.08	3.10	2.88	2.06	2.00	4.83	3.84
21	2.72	2.45	2.70	3.78	4.88	5.02	3.08	3.02	2.40	2.00	5.05	3.70
22	2.75	2.42	2.68	3.75	4.78	4.75	3.15	3.10	2.32	1.96	4.92	3.60
23	2.72	2.38	2.68	3.85	4.75	4.52	3.18	3.02	2.26	1.95	7.20	3.57
24	2.62	2.38	2.72	3.92	4.88	4.42	3.20	2.90	2.26	1.96	9.50	3.54
25	2.50	2.40	2.82	4.10	5.22	4.28	3.14	2.90	2.23	2.00	8.55	3.47
26	2.50	2.35	2.98	4.55	5.70	4.20	3.00	2.88	2.21	1.96	7.00	3.47
27	2.42	2.28	3.15	4.80	5.02	4.38	3.12	2.90	2.18	1.96	6.10	3.37
28	2.40	2.30	3.32	4.78	6.12	4.35	3.01	2.88	2.18	1.96	5.78	3.38
29	2.32	.....	3.48	4.68	5.92	4.25	3.06	2.68	2.18	1.98	6.52	3.44
30	2.28	.....	3.58	4.62	5.72	4.22	3.06	2.62	2.20	1.98	9.34	3.47
31	2.28	.....	3.58	.....	5.68	.....	3.12	2.62	.....	1.98	.....	3.46

NOTE.—On Jan. 6 there was ice along edges and channel was full of floating ice.

Daily discharge, in second-feet, of Yakima River at Clealum, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	713	598	644	1,750	2,920	6,510	2,680	1,220	926	579	495	12,700
2	698	566	684	1,650	3,000	9,030	2,700	1,220	988	579	684	8,720
3	698	556	630	1,560	3,520	9,720	2,740	1,220	965	554	2,820	6,250
4	735	554	630	1,520	3,030	8,530	2,780	1,220	942	536	3,660	4,820
5	757	554	598	1,430	5,420	7,360	2,700	1,220	918	530	3,520	4,010
6	926	554	566	1,430	4,600	6,720	2,630	1,210	910	512	3,320	3,520
7	926	566	554	1,380	3,840	6,000	2,450	1,140	848	548	3,060	3,160
8	848	536	579	1,330	3,490	5,710	2,250	1,110	833	560	2,910	2,860
9	735	506	617	1,350	3,320	5,710	2,120	1,120	810	554	2,860	2,670
10	698	506	598	1,480	3,350	5,860	1,990	1,120	757	548	2,700	2,450
11	735	506	579	1,650	3,290	6,250	1,960	1,100	684	542	2,620	2,390
12	644	495	579	1,770	3,030	6,380	2,020	1,120	644	554	2,490	2,530
13	598	495	644	1,960	3,080	6,000	1,990	1,140	579	542	2,350	3,750
14	735	495	713	2,280	3,290	5,300	1,830	1,080	536	530	2,780	3,730
15	757	478	757	2,350	3,520	5,190	1,670	1,220	506	518	2,350	3,320
16	698	536	810	2,280	3,630	5,350	1,560	1,140	495	495	1,670	2,960
17	684	664	864	2,150	3,580	4,970	1,520	1,120	478	489	1,430	2,670
18	698	787	942	2,080	3,660	4,540	1,410	1,160	472	478	1,470	2,420
19	713	848	942	1,990	3,800	4,130	1,310	1,140	461	461	2,530	2,240
20	848	810	965	1,990	3,880	3,990	1,240	1,070	484	450	3,540	2,070
21	942	735	926	1,990	3,630	3,880	1,220	1,180	698	450	3,940	1,890
22	965	713	910	1,960	3,460	3,400	1,280	1,240	644	430	3,700	1,770
23	942	684	910	2,080	3,400	3,030	1,310	1,180	604	425	9,400	1,730
24	864	684	942	2,180	3,630	2,880	1,330	1,080	604	430	17,300	1,700
25	772	698	1,020	2,420	4,270	2,670	1,280	1,080	585	450	13,900	1,620
26	772	664	1,140	3,080	5,300	2,560	1,160	1,070	572	430	8,780	1,620
27	713	617	1,280	3,490	3,880	2,820	1,260	1,080	554	430	6,250	1,510
28	698	630	1,450	3,460	6,300	2,780	1,170	1,070	554	430	5,480	1,520
29	644	.....	1,630	3,290	5,810	2,630	1,210	910	554	440	7,360	1,580
30	617	.....	1,750	3,190	5,350	2,590	1,210	864	566	440	16,700	1,620
31	617	.....	1,750	.....	5,260	.....	1,260	864	.....	440	.....	1,610

NOTE.—These daily discharges are based on a rating curve that is well defined above a discharge of 480 second-feet.

Monthly discharge of Yakima River at Clealum, Wash., for 1909.

[Drainage area, 500 square miles.]

Month.	Observed discharge in second-feet.			Run-off in acre-feet.			Discharge without storage in second-feet.		Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	Mean.	Mean per square mile.		
January	965	598	755	46,400	− 1,000	45,400	738	1.48	1.71	A.
February	848	478	609	33,800	− 370	33,400	601	1.20	1.25	A.
March	1,750	554	890	54,700	+ 2,940	57,600	937	1.87	2.16	A.
April	3,490	1,330	2,080	124,000	+ 4,720	129,000	2,170	4.34	4.84	A.
May	6,300	2,920	3,820	235,000	+ 7,580	243,000	3,950	7.90	9.11	A.
June	9,720	2,560	5,080	302,000	+ 4,260	306,000	5,140	10.3	11.49	A.
July	2,780	1,160	1,780	109,000	− 6,440	103,000	1,680	3.36	3.87	A.
August	1,240	864	1,120	68,900	−33,100	35,800	582	1.16	1.34	A.
September	988	461	672	40,000	−11,500	28,500	479	.958	1.07	A.
October	579	425	495	30,400	− 1,580	28,800	468	.936	1.08	A.
November	17,300	495	4,740	282,000	+65,600	348,000	5,850	11.7	13.05	A.
December	12,700	1,510	3,060	188,000	−36,300	152,000	2,470	4.94	5.70	A.
The year	17,300	425	2,090	1,510,000	.....	1,510,000	2,090	4.18	56.67	

YAKIMA RIVER AT UMTANUM, WASH.

The station which was established August 25, 1906, at Umtanum, Wash., in the canyon of Yakima River between the Kittitas and Selah valleys, 1 mile above the mouth of Umtanum Creek, affords data that are valuable in the general scheme of reclamation undertaken by the United States Reclamation Service. The records indicate the amount of water available from Yakima River for the Selah and Moxee valleys and show also the amount passing the Kittitas Valley after all seepage waters from irrigation are returned to the river. The records are also extensively used during the irrigating season at this point in conjunction with those at Clealum and Union Gap in studying the most economic method of operating storage reservoirs which are contemplated and under construction for the irrigation of the valley.

The vertical staff gage is in four sections, located as follows: The low-water section is in the right bank back of the section house; section 2 is a staff 25 feet downstream; section 3 is 50 feet back of the low-water section; and the high-water section is 20 feet back of the third section. Discharge measurements are made by means of a cable equipment 75 feet upstream from the low-water section.

The conditions are favorable for good results and the data obtained are reliable. A riffle control is located about 300 feet below the gaging section, and the gage height is a good index of the flow. Gage heights are somewhat affected during the winter months by ice, but, as the ice periods are short and do not occur at critical stages, the errors due to this cause are not great.

Discharge measurements of Yakima River at Umtanum, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 16	H. D. McGlashan	247	1,490	6.27	6,130
July 30	H. Kimble	240	786	3.90	1,050
Sept. 23	do	234	633	3.30	487
Nov. 9	do	245	1,100	5.23	3,220
Dec. 17[a]	do	245	1,040	5.30	3,090

[a] Channel filled up in flood.

Daily gage heights, in feet, of Yakima River at Umtanum, Wash., for 1909.

[J. B. Freeman, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.75	5.4	3.8	4.9	5.3	6.7	4.8	3.9	3.6	3.3	3.52	9.25
2	3.7	5.4	3.8	4.85	5.42	7.12	4.9	3.9	3.5	3.3	3.6	7.75
3	3.7	5.45	3.75	4.8	5.68	7.45	4.9	3.9	3.5	3.35	4.65	7.22
4	3.7	5.5	3.75	4.7	6.25	7.45	4.9	3.9	3.6	3.35	5.8	6.5
5	3.7	5.4	3.75	4.7	6.55	7.0	4.9	3.85	3.6	3.4	5.6	6.0
6	3.65	5.25	3.75	4.7	6.2	6.7	4.9	3.8	3.6	3.45	5.5	5.78
7	3.6	3.6	3.7	4.65	5.8	6.5	4.8	3.75	3.5	3.5	5.4	5.6
8	3.6	3.62	3.7	4.65	5.72	6.3	4.78	3.7	3.5	3.55	5.4	5.4
9	3.58	3.62	3.75	4.6	5.5	6.3	4.58	3.7	3.45	3.55	5.32	5.25
10	4.95	3.6	3.75	4.72	5.5	6.3	4.5	3.7	3.4	3.4	5.22	5.1
11	5.75	3.5	3.75	4.82	5.5	6.3	4.5	3.7	3.4	3.4	5.15	5.0
12	5.5	3.5	3.75	4.95	5.48	6.55	4.4	3.7	3.4	3.4	5.12	5.3
13	5.5	3.55	3.88	5.12	5.4	6.45	4.35	3.7	3.3	3.4	5.1	5.6
14	5.5	3.55	4.05	5.28	5.45	6.3	4.35	3.7	3.3	3.4	5.0	5.78
15	5.5	3.55	4.1	5.3	5.65	6.2	4.32	3.7	3.3	3.4	4.9	5.55
16	5.5	3.55	4.1	5.28	5.8	6.15	4.3	3.7	3.2	3.4	4.8	5.48
17	6.0	4.15	4.2	5.2	5.82	6.1	4.22	3.75	3.25	3.4	4.85	5.4
18	6.0	4.6	4.2	5.12	5.85	5.95	4.12	3.75	3.2	3.4	5.05	5.15
19	6.5	4.52	4.15	5.0	5.95	5.75	4.08	3.75	3.2	3.4	5.15	5.02
20	6.55	4.2	4.1	5.0	6.08	5.58	4.0	3.75	3.2	3.4	5.25	4.9
21	6.5	3.95	4.12	4.98	6.15	5.45	4.0	3.75	3.2	3.4	5.82	4.8
22	6.3	3.9	4.15	4.92	6.08	5.4	3.9	3.75	3.3	3.4	7.5	4.75
23	6.3	3.85	4.15	4.95	6.05	5.28	3.8	3.75	3.32	3.4	9.35	4.5
24	6.0	3.8	4.2	5.0	6.18	5.15	4.0	3.75	3.35	3.4	9.5	4.5
25	5.5	3.85	4.25	5.1	6.25	5.02	4.0	3.75	3.3	3.4	10.35	4.5
26	5.55	3.85	4.3	5.4	6.42	5.0	3.95	3.75	3.3	3.4	9.75	4.45
27	5.4	3.85	4.42	5.58	6.65	5.0	3.9	3.75	3.3	3.45	7.12	4.6
28	5.3	3.8	4.85	5.68	6.6	5.0	3.9	3.75	3.3	3.45	7.15	4.5
29	5.3	.....	4.95	5.5	6.5	5.0	3.9	3.7	3.3	3.45	8.32	4.5
30	5.3	.....	5.02	5.4	6.3	4.8	3.9	3.62	3.3	3.45	8.75	4.5
31	5.35	.....	4.9	.....	6.5	.....	3.85	3.6	.....	3.45	.....	4.4

NOTE.—Ice conditions: Jan. 5 to 8, slush ice running; Jan. 9, river partially frozen over; Jan. 10 to Feb. 6, river entirely frozen over and backwater caused by ice jam below station; Feb. 7, open channel except along edges; Dec. 18 to 31, slush ice running.

Daily discharge, in second-feet, of Yakima River at Umtanum, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	900	740	950	2,560	3,370	7,360	2,380	1,060	750	490	678	18,700
2	850	740	950	2,470	3,640	8,980	2,560	1,060	660	490	750	11,300
3	850	730	900	2,380	4,260	10,300	2,560	1,060	660	530	2,120	9,040
4	850	730	900	2,200	5,840	10,300	2,560	1,060	750	530	4,570	6,450
5	850	730	900	2,200	6,830	8,500	2,560	1,000	750	570	4,060	4,900
6	800	740	900	2,200	5,680	7,360	2,560	950	750	615	3,820	4,290
7	750	750	850	2,120	4,570	6,660	2,380	900	660	660	3,590	3,810
8	750	770	850	2,120	4,360	6,000	2,340	850	660	705	3,590	3,320
9	732	770	900	2,030	3,820	6,000	2,000	850	615	705	3,410	3,000
10	860	750	900	2,240	3,820	6,000	1,870	850	570	570	3,200	2,690

Daily discharge, in second-feet, of Yakima River at Umtanum, Wash., for 1909—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
11	860	660	900	2,420	3,820	6,000	1,870	850	570	570	3,060	2,500
12	860	660	900	2,660	3,770	6,830	1,710	850	570	570	2,990	3,100
13	870	705	1,040	2,990	3,590	6,490	1,640	850	490	570	2,950	3,810
14	870	705	1,230	3,330	3,700	6,000	1,640	850	490	570	2,750	4,290
15	870	705	1,290	3,370	4,180	5,680	1,590	850	490	570	2,560	3,680
16	860	705	1,290	3,330	4,570	5,530	1,560	850	410	570	2,380	3,510
17	860	1,360	1,420	3,160	4,620	5,380	1,450	900	450	570	2,470	3,320
18	860	2,030	1,420	2,990	4,700	4,960	1,320	900	410	570	2,850	2,790
19	900	1,900	1,360	2,750	4,960	4,440	1,270	900	410	570	3,060	2,540
20	1,000	1,420	1,290	2,750	5,320	4,010	1,170	900	410	570	3,260	2,320
21	1,050	1,120	1,320	2,710	5,530	3,700	1,170	900	410	570	4,620	2,140
22	1,100	1,060	1,360	2,600	5,320	3,590	1,060	900	490	570	10,500	2,060
23	1,200	1,000	1,360	2,660	5,240	3,330	950	900	506	570	19,400	1,660
24	1,100	950	1,420	2,750	5,620	3,060	1,170	900	530	570	20,200	1,660
25	1,000	1,000	1,490	2,950	5,840	2,790	1,170	900	490	570	24,500	1,660
26	950	1,000	1,560	3,590	6,390	2,750	1,120	900	490	570	21,400	1,580
27	900	1,000	1,740	4,010	7,180	2,750	1,060	900	490	615	8,660	1,810
28	820	950	2,470	4,260	7,000	2,750	1,060	900	490	615	8,770	1,660
29	810	.....	2,660	3,820	6,660	2,750	1,060	850	490	615	14,000	1,660
30	800	.....	2,790	3,590	6,000	2,380	1,060	770	490	615	16,200	1,660
31	740	.....	2,560	.....	6,660	.....	1,000	750	.....	615	.....	1,510

NOTE.—These discharges, except for the frozen period Jan. 10 to Feb. 6, are based on rating curves applicable as follows: Jan. 1 to Nov. 25, 1909, well defined between discharges of 410 and 6,700 second-feet; Nov. 26 to Dec. 31, 1909, fairly well defined below a discharge of 6,100 second-feet. Discharges during the frozen period estimated by intercomparison with the station at Clealum.

Monthly discharge of Yakima River at Umtanum, Wash., for 1909.

[Drainage area, 1,540 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	886	0.575	0.66	54,500	C.
February	2,030	660	942	.612	.64	52,300	B.
March	2,790	850	1,350	.877	1.01	83,000	A.
April	4,260	2,030	2,840	1.84	2.05	169,000	A.
May	7,180	3,370	5,060	3.29	3.79	311,000	A.
June	10,300	2,380	5,420	3.52	3.93	323,000	A.
July	2,560	950	1,640	1.06	1.22	101,000	A.
August	1,060	750	900	.584	.67	55,300	A.
September	750	410	547	.355	.40	32,500	B.
October	705	490	583	.379	.44	35,800	B.
November	24,500	678	6,880	4.47	4.99	409,000	B.
December	18,700	1,510	3,820	2.48	2.86	235,000	B.
The year	24,500	410	2,570	1.67	22.66	1,860,000	

YAKIMA RIVER NEAR YAKIMA, WASH.

This station is located at Union Gap, a short canyon through Atanum Ridge near Yakima, Wash. It was established August 14, 1893, but discharge can be computed only from August 19, 1895, as the records are fragmentary prior to that date. This station was discontinued December 31, 1909, in favor of the Wapato station.

The station is of importance to the determination of the discharge of the river, as it is located at a critical point unaffected by the diversion of water for the large irrigated areas above and below. It is just

below the mouth of Atanum Creek and above the head gate of the New Reservation canal; there is only a short stretch of river in which the station can be located, the distance between these points being less than half a mile. The discharge at this point is approximately equal to the sum of the discharge of Yakima River at Umtanum, Naches River at North Yakima, Atanum Creek, the return waters in the Selah and Moxee valleys, and the waste from the North Yakima power canal. The records show also the amount of water available for the Sunnyside and Old and New Reservation canals, all of which have their intakes a short distance below.

The records were fairly reliable until the flood of November 15, 1906, which so deepened the channel at the measuring section that the current is very sluggish at low water. The flood also deepened a small channel near the left bank, which previously did not carry water except at flood periods, but which now carries a considerable portion of the flow even at medium stages. On account of these changes it has been impossible since the above date to obtain reliable estimates of discharge. The record of gage heights for 1909 is not published as the gage heights are not a true index of the discharge. The monthly discharge may be computed, however, by adding the flow of the three canals to the flow over the Sunnyside dam.

The datum of the gage has not been changed since the station was established, but a number of rating curves have been used on account of changing conditions.

The river frequently freezes during the winter months, and ice jams are common in the vicinity of the station.

YAKIMA RIVER NEAR WAPATO, WASH.

This station, which was established April 25, 1908, is located just below the head gate of the Sunnyside canal, which is owned and operated by the United States Reclamation Service.

The flow at this point is controlled by a concrete diversion dam 500 feet long, of ogee cross section 7 feet high. A sluiceway in the dam is closed by means of flashboards during the irrigating season. There is also a fish ladder near the sluiceway through which a small quantity of water flows all the time.

Discharge measurements are made from a cable which spans the river 1,000 feet below the dam. Two gages were read in 1909—a hook gage and a chain gage. The hook gage is in the fore bay above the controlling gates for Sunnyside canal and indicates head of water flowing over the dam. An auxiliary gage installed above the dam was used when the hook gage was frozen up, these readings being corrected to the hook gage datum. The chain gage is located at the cable section at an arbitrary datum. The relation between the gages has been

determined and all gage heights for 1909 are referred to the datum of the chain gage. Owing to variable effect of drift logs on the crest of the dam the hook gage heights are not a good index of discharge. Those obtained from the chain gage have therefore been used in determining discharge. The records are reliable.

The results obtained at this station, when added to the diversions measured in the Sunnyside canal, the Old and New Reservation canals are comparable with records formerly obtained at Union Gap.

Discharge measurements of Yakima River near Wapato, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				Gage at cable.	Hook gage at dam.	
		Feet.	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
Jan. 22	L. R. Allen	272	1,320	3.78	1.59	3.210
Feb. 16	do	270	974	2.53	.88	1,440
18	do	275	1,330	3.82	1.55	3.250
May 4	do	288	1,930	5.46	2.76	8,400
12	do	280	1,540	4.54	1.85	4,980
26	do	288	1,910	5.50	2.57	8.220
June 3	Stevens and Allen	302	2,420	7.35	4.33	16,500
18	L. R. Allen	288	1,870	5.78	2.87	8.720
25	Allen and Harris	280	1,520	4.53	1.90	4,790
July 13	L. R. Allen	273	1,210	3.45	1.23	2,760
14	H. Kimble	272	1,140	3.25	1.12	2,240
23	L. R. Allen	269	808	1.96	.47	939
31	do	266	710	1.59	.30	719
Aug. 10	do	264	549	.98	.14	336
13	C. F. Gleason	265	502	.80	.....	225
23	L. R. Allen	264	529	.89	.18	290
Sept. 4	C. F. Gleason	265	470	.74	.....	229
6	L. R. Allen	262	457	.61	.11	191
25	do	252	428	.46	.11	164
Nov. 24[a]	C. F. Gleason	303	2,970	9.65	6.05	32,000

[a] This measurement is liable to be considerably in error, due to insufficient weight and absence of stay line in making measurement.

Daily gage height, in feet, of Yakima River near Wapato, Wash., for 1909.

[W. R. Newland, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.62	2.83	2.86	4.10	4.20	5.84	3.95	1.57	0.38	0.95	0.76	9.05
2	2.60	2.82	2.72	4.10	4.21	6.75	3.92	1.62	.40	1.00	1.34	8.02
3	2.55	3.00	2.75	3.96	4.68	7.22	3.96	1.49	.61	1.00	4.47	6.95
4	2.55	3.00	2.78	3.82	5.34	7.00	4.06	1.46	.51	.99	5.53	6.28
5	2.55	2.84	2.72	3.72	5.83	6.73	4.01	1.41	.46	.98	5.26	5.82
6	.....	2.70	2.67	3.58	5.64	6.46	4.01	1.34	.46	1.02	4.95	5.54
7	.....	2.68	2.60	3.55	5.18	6.25	3.98	1.20	.43	1.10	4.72	5.25
8	.....	2.65	2.54	3.39	4.85	6.02	3.86	1.08	.84	1.11	4.53	5.06
9	.....	2.58	2.60	3.42	4.73	5.85	3.76	1.00	.52	1.12	4.48	4.94
10	.....	2.55	2.56	3.60	4.65	5.83	3.62	.95	.36	1.17	4.38	4.75
11	.....	2.50	2.56	3.76	4.60	5.98	3.58	.84	.16	1.14	4.26	4.62
12	.....	2.48	2.57	3.83	4.49	6.19	3.52	.70	.00	1.10	4.23	4.59
13	.....	2.47	2.62	4.08	4.44	6.22	3.41	.66	.00	1.06	4.08	5.04
14	.....	2.50	2.92	4.25	4.55	5.95	3.19	.62	−.22	1.02	3.99	5.14
15	.....	2.51	3.04	4.32	4.65	5.83	3.02	.62	−.18	1.00	3.65	5.01
16	.....	2.65	3.18	4.22	4.80	5.87	2.88	.55	−.22	.95	3.48	4.90
17	.....	2.90	3.20	4.11	4.86	5.86	2.73	.70	−.50	.83	3.41	4.70
18	.....	4.00	3.14	4.00	4.74	5.74	2.66	.72	−.40	.80	3.50	4.46
19	3.20	3.88	3.27	3.83	4.82	5.60	2.39	.70	−.16	.80	5.03	4.36
20	3.05	3.35	3.20	3.76	4.88	5.54	2.16	.72	−.50	.82	5.66	4.22

Daily gage height, in feet, of Yakima River near Wapato, Wash., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.90	3.06	3.16	3.77	4.84	5.32	2.01	.72	− .29	.86	5.45	3.95
22	3.85	2.89	3.09	3.69	4.74	5.16	1.91	.80	− .12	.86	5.36	3.81
23	3.70	2.80	3.06	3.71	4.63	4.85	1.93	.84	.40	.84	6.98	3.76
24	3.60	2.88	3.04	3.82	4.63	4.66	1.94	.90	.32	.68	9.38	3.72
25	3.20	2.90	3.24	3.87	4.78	4.46	1.91	.82	.31	.84	9.82	3.81
26	3.20	2.84	3.42	4.12	5.28	4.30	1.90	.81	.31	.78	8.20	3.83
27	3.20	2.89	3.62	4.60	5.74	4.38	1.82	.88	.35	.84	6.98	3.77
28	3.15	2.79	4.60	4.64	6.10	4.34	1.68	.99	.45	.81	6.42	3.61
29	2.96	.....	4.12	4.48	6.00	4.24	1.67	.79	.64	.80	6.70	3.56
30	2.91	.....	4.20	4.28	5.74	3.94	1.68	.68	.73	.86	8.68	3.54
31	2.85	.....	4.11	.....	5.64	.....	1.60	.45	.....	.86	.....	3.54

NOTE.—Ice from Jan. 6 to 17 but flow at cable station was not affected.

Daily discharge, in second-feet, of Yakima River near Wapato, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,540	1,800	1,830	3,880	4,100	9,120	3,560	664	138	315	240	27,000
2	1,520	1,780	1,660	3,880	4,120	13,400	3,500	700	142	338	514	20,300
3	1,470	2,000	1,700	3,590	5,240	15,800	3,590	608	193	338	4,730	14,400
4	1,470	2,000	1,740	3,300	7,200	14,000	3,800	589	168	333	7,890	11,100
5	1,470	1,810	1,660	3,110	9,070	13,200	3,690	556	156	329	6,920	9,030
6	1,530	1,640	1,600	2,870	8,310	12,000	3,690	514	156	348	5,960	7,930
7	1,590	1,620	1,520	2,820	6,600	11,000	3,630	435	149	386	5,340	6,890
8	1,650	1,580	1,400	2,560	5,080	9,920	3,380	376	268	391	4,870	6,280
9	1,710	1,500	1,520	2,610	5,370	9,160	3,180	338	170	396	4,750	5,930
10	1,770	1,470	1,480	2,900	5,160	9,070	2,930	315	134	420	4,510	5,420
11	1,830	1,420	1,480	3,180	5,040	9,740	2,870	268	94	406	4,240	5,090
12	1,890	1,400	1,490	3,320	4,780	10,700	2,770	220	69	386	4,170	5,020
13	1,950	1,390	1,540	3,840	4,660	10,800	2,600	208	69	367	3,840	6,220
14	2,010	1,420	1,900	4,220	4,920	9,600	2,260	196	41	348	3,650	6,530
15	2,070	1,430	2,050	4,380	5,160	9,070	2,030	196	46	338	2,980	6,130
16	2,120	1,580	2,240	4,150	5,550	9,250	1,830	178	41	315	2,710	5,820
17	2,170	1,880	2,270	3,900	5,710	9,200	1,680	220	12	264	2,600	5,290
18	2,220	3,670	2,190	3,670	5,390	8,700	1,590	227	21	253	2,740	4,700
19	2,270	3,420	2,380	3,320	5,000	8,150	1,320	220	48	253	6,190	4,470
20	2,060	2,500	2,270	3,180	5,770	7,930	1,120	227	12	261	8,380	4,150
21	1,880	2,080	2,210	3,200	5,660	7,130	998	227	32	276	7,600	3,560
22	3 360	1,870	2,120	3,050	5,390	6,590	918	253	53	276	7,270	3,280
23	3,070	1,700	2,080	3,090	5,120	5,680	934	268	142	268	13,600	3,180
24	2,900	1,860	2,050	3,300	5,120	5,190	942	291	125	214	29,500	3,110
25	2,270	1,880	2,330	3,400	5,500	4,700	918	261	123	268	33,400	3,280
26	2,270	1,810	2,610	3,920	6,990	4,330	910	257	123	246	21,400	3,320
27	2,270	1,870	2,930	5,040	8,700	4,510	848	283	132	268	14,500	3,200
28	2,200	1,750	3,670	5,140	10,300	4,420	743	333	154	257	11,800	2,920
29	1,950	.....	3,920	4,750	9,830	4,190	736	250	202	253	13,100	2,840
30	1,890	.....	4,100	4,280	8,700	3,540	743	214	230	276	24,500	2,800
31	1,820	.....	3,900	.....	8,310	.....	685	156	.....	276	.....	2,800

NOTE.—These discharges are based on a rating curve that is well defined above a discharge of 100 second-feet, except for extreme high water, when it is rather uncertain, Below this the curve is only approximate. Discharges from Jan. 6 to 18 interpolated.

Monthly discharge of Yakima River near Wapato, Wash., for 1909.

[Drainage area, 3,300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	3,360	1,470	2,010	0.609	0.7	124,000	B.
February	3,670	1,390	1,860	.564	.59	103,000	A.
March	4,100	1,460	2,190	.664	.77	135,000	A.
April	5,140	2,560	3,600	1.09	1.22	214,000	A.
May	10,300	4,100	6,230	1.89	2.18	383,000	A.
June	15,800	3,540	8,690	2.63	2.93	517,000	A.
July	3,800	685	2,080	.63	.73	128,000	A.
August	700	156	324	.098	.11	19,960	A.
September	268	12	115	.035	.04	6,840	B.
October	420	214	312	.094	.11	19,200	A.
November	33,400	240	8,800	2.67	2.98	524,000	B.
December	27,000	2,800	6,520	1.98	2.28	401,000	A.
The year	33,400	12	3,560	1.08	14.64	2,570,000	

YAKIMA RIVER AT KIONA, WASH.

This station was established August 20, 1895, at the highway bridge about 1,800 feet northwest of the Northern Pacific Railway station. No tributaries enter in the vicinity of this station.

The chief value of the data lies in the fact that they cover a long period and are accurate. Much water is diverted from the river, both below and above the station. At the medium and high stages the total amount of diverted water is but a small per cent of the flow of the river, but at low stages this condition is reversed, and the water passing Kiona consists in large part of return water from irrigation. The data obtained here are, however, of value as indicating the flow at Prosser, which, on account of certain water rights, becomes of considerable importance. Between Prosser and Kiona, a distance of 14 miles, there is only one diversion of consequence, the Kiona canal and one contribution to the stream, the Prosser wasteway at the end of the Sunnyside canal.

The flow at the gaging station is controlled by a riffle about 1,000 feet below the bridge, and this control has made the development of a permanent rating curve possible. The chain gage now used was installed May 8, 1906, on the bridge from which discharge measurements are made, to replace the old wire gage and staff gages formerly used. All gage heights have been corrected to a uniform datum. During the winter months a small amount of ice is apt to form in the vicinity of the station, but only in exceptional seasons does this ice interfere with the determination of flow.

Discharge measurements of Yakima River at Kiona, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 23	L. R. Allen	263	1,570	7.10	5,130
Aug. 2	H. Kimble	212	742	3.98	831
27	C. F. Gleason	206	582	3.25	420
Sept. 28	H. Kimble	209	589	3.21	430
Oct. 16	G. L. Parker	212	736	3.90	772
Nov. 19	H. Kimble	231	1,270	5.99	3,400
Dec. 18	C. F. Gleason	287	1,720	7.92	6,500

Daily gage height, in feet, of Yakima River at Kiona, Wash., for 1909.

[Mrs. J. H. Kennedy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.20	5.41	5.37	7.02	6.45	8.99	6.51	3.97	3.31	3.04	3.79	12.78
2	4.85	5.43	5.33	7.11	6.80	9.49	6.48	3.95	2.41	3.04	4.11	14.08
3	4.95	5.28	5.37	7.06	6.97	10.59	6.46	4.20	2.81	2.70	4.13	13.54
4	4.90	5.36	5.32	6.86	7.51	11.16	6.45	4.21	3.01	3.04	7.29	11.60
5	4.85	5.53	5.29	6.78	8.57	11.20	6.53	4.14	2.91	3.50	8.33	10.28
6	4.60	5.30	5.34	6.65	9.05	11.71	6.45	3.68	2.89	3.52	7.99	9.58
7	6.50	5.37	5.29	6.64	8.70	10.22	6.43	3.67	2.91	3.46	7.64	9.08
8	9.20	5.20	5.25	6.30	8.15	9.81	6.33	3.64	2.81	3.51	7.39	8.78
9	9.20	5.10	5.17	6.22	7.75	9.59	6.25	3.57	2.91	3.68	7.25	8.48
10	9.20	5.00	5.13	6.16	7.61	9.32	6.15	3.66	2.81	3.72	7.14	8.18
11	9.00	4.98	5.17	6.36	7.53	9.34	6.03	3.69	2.77	3.76	7.07	7.88
12	8.50	4.94	5.12	6.48	7.43	9.49	5.98	3.67	2.87	3.76	6.91	8.14
13	8.50	4.88	5.17	6.55	7.21	9.72	5.93	3.66	2.87	3.80	6.79	8.52
14	8.50	4.86	5.15	6.78	7.15	9.68	5.75	3.56	2.87	3.86	6.65	8.72
15	8.50	4.93	5.57	7.04	7.35	9.34	5.56	3.52	2.77	3.90	6.51	8.78
16	7.40	5.22	5.70	7.08	7.51	9.44	5.35	3.47	2.73	3.90	6.19	8.60
17	7.00	5.43	5.85	6.98	7.80	9.39	5.15	3.42	2.91	3.84	6.01	8.28
18	7.00	6.20	5.97	6.86	7.70	9.29	5.11	3.37	2.91	3.78	5.93	7.90
19	8.50	6.73	6.07	6.61	7.72	9.04	5.03	3.27	2.93	3.66	6.01	7.68
20	7.00	6.56	6.05	6.56	7.75	8.84	4.75	3.27	2.91	3.76	8.19	7.64
21	7.42	6.16	5.99	6.51	7.80	8.64	4.58	3.24	2.71	3.80	8.79	7.18
22	7.55	5.98	5.95	6.50	7.75	8.54	4.49	3.22	2.83	3.76	8.63	6.82
23	7.32	5.78	6.83	6.36	7.60	8.24	4.33	3.12	2.87	3.74	8.79	6.32
24	6.59	5.66	5.79	6.38	7.43	7.80	4.19	3.02	2.91	3.70	11.35	6.38
25	6.19	5.58	5.89	6.46	7.43	7.54	4.16	3.07	3.09	3.72	12.89	6.52
26	5.87	5.60	5.99	6.53	7.75	7.24	4.13	3.07	2.97	3.80	14.49	6.58
27	5.65	5.56	6.22	6.88	8.52	7.04	3.81	3.20	3.03	3.80	13.79	6.52
28	5.54	5.49	6.57	7.44	9.23	7.02	3.65	2.82	3.13	3.86	11.69	6.50
29	5.36	.....	6.87	7.44	9.53	6.99	3.58	3.06	3.21	3.86	10.71	6.48
30	5.38	.....	7.07	7.36	9.43	6.94	3.65	2.86	3.19	3.90	11.03	6.68
31	5.41	.....	7.12	.....	9.07	.....	3.75	2.92	.....	3.90	.....	6.38

NOTE.—Ice conditions: During January the stream flow was affected by slush ice, ice jams, and backwater. From Jan. 8 to 19 the channel was entirely frozen over and gage heights are to water surface. The ice began to break up Jan. 19, the channel being open Jan. 20 with ice cakes running.

Daily discharge, in second-feet, of Yakima River at Kiona, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,150	2,430	2,380	5,180	4,080	9,570	4,190	834	445	331	714	21,100
2	1,720	2,460	2,320	5,360	4,740	10,800	4,130	820	123	331	944	26,800
3	1,840	2,250	2,380	5,260	5,080	13,800	4,100	1,020	248	210	960	24,300
4	1,780	2,360	2,310	4,860	6,200	15,500	4,080	1,030	319	331	5,740	16,900
5	1,720	2,600	2,270	4,700	8,560	15,600	4,220	969	284	540	8,010	12,900
6	1,420	2,280	2,340	4,440	9,710	17,200	4,080	643	276	551	7,250	11,000
7	1,680	2,380	2,270	3,430	8,870	12,700	4,040	637	284	520	6,480	9,780
8	1,940	2,150	2,220	3,820	7,600	11,600	3,870	619	248	562	5,950	9,060
9	2,190	2,020	2,110	3,680	6,720	11,000	3,740	578	284	643	5,660	8,350
10	2,450	1,900	2,060	3,580	6,410	10,400	3,560	631	248	668	5,380	7,670

Daily discharge, in second-feet, of Yakima River at Kiona, Wash., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	2,710	1,880	2,110	3,920	6,240	10,400	3,370	649	234	694	5,280	7,010
12	2,970	1,830	2,050	4,130	6,030	10,800	3,290	637	270	694	4,960	7,580
13	3,220	1,760	2,110	4,260	5,570	11,400	3,210	631	270	720	4,720	8,450
14	3,480	1,730	2,080	4,700	5,440	11,300	2,920	573	270	759	4,440	8,920
15	3,740	1,820	2,660	5,220	5,860	10,400	2,640	551	234	785	4,199	9,060
16	4,000	2,180	2,850	5,300	6,200	10,700	2,350	525	220	785	3,630	8,630
17	4,250	2,460	3,080	5,100	6,830	10,500	2,080	500	284	746	3,340	7,890
18	4,510	3,650	3,270	4,860	6,610	10,300	2,030	475	284	707	3,210	7,050
19	4,770	4,600	3,430	4,370	6,650	9,690	1,940	426	290	631	3,340	6,570
20	5,030	4,280	3,400	4,280	6,720	9,210	1,600	426	284	*694	7,690	6,480
21	5,280	3,580	3,300	4,190	6,830	8,730	1,400	413	214	720	9,090	5,510
22	5,540	3,290	3,240	4,170	6,720	8,490	1,300	404	256	694	8,700	4,780
23	5,800	2,970	4,800	3,920	6,390	7,800	1,140	363	270	681	9,090	3,850
24	4,330	2,790	2,980	3,960	6,030	6,830	1,010	323	284	655	16,100	3,960
25	3,630	2,670	3,140	4,100	6,030	6,260	986	343	351	668	21,500	4,210
26	3,110	2,700	3,300	4,220	6,720	5,630	960	343	304	720	29,000	4,310
27	2,780	2,640	3,680	4,900	8,450	5,220	726	395	327	720	25,400	4,210
28	2,620	2,550	4,300	6,050	10,100	5,180	625	252	367	759	17,200	4,170
29	2,360	.....	4,880	6,050	10,900	5,120	584	339	400	759	14,100	4,130
30	2,390	.....	5,280	5,890	10,600	5,020	625	266	391	785	15,000	4,500
31	2,430	.....	5,380	.....	9,760	.....	688	287	.....	785	.....	3,960

NOTE.—These discharges, except the ice period, are based on a rating curve that is well defined above 150 second-feet. Discharges for ice period interpolated.

Monthly discharge of Yakima River at Kiona, Wash., for 1909.

[Drainage area, 5,230 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	5,800	1,420	3,160	0.604	0.70	194,000	B.
February	4,600	1,730	2,580	.493	.51	143,000	A.
March	5,380	2,050	3,030	.579	.67	186,000	A.
April	6,050	3,430	4,600	.880	.98	274,000	A.
May	10,900	4,080	7,050	1.35	1.56	433,000	A.
June	17,200	5,020	9,900	1.89	2.11	589,000	A.
July	4,220	584	2,430	.464	.53	149,000	A.
August	1,030	252	545	.104	.12	33,500	A.
September	445	123	285	.054	.06	17,000	A.
October	785	210	640	.122	.14	39,400	A.
November	29,000	714	8,570	1.64	1.83	510,000	A.
December	26,800	3,850	8,810	1.68	1.94	542,000	A.
The year	29,000	123	4,300	.822	11.15	3,110,000	

YAKIMA RIVER NEAR RICHLAND, WASH.

This station, which is located below all diversions, is maintained during the later part of irrigating seasons only to determine the amount of water flowing from the Yakima into Columbia River during the low-water period.

The station was originally established at Richland Ferry, Wash., 8 miles above Kennewick and 2½ miles above the mouth of the river. It was moved during 1908 to a highway bridge on the road from Richland to Kennewick, half a mile above the mouth of the river, where more favorable measuring conditions existed.

The gage used in 1906 was located 500 feet below the ferry. On August 13, 1907, a staff gage was installed on an old bridge pier at the ferry. The staff gage which was set August 28, 1908, at the highway bridge at a different datum was not found in 1909; consequently a new staff was fastened to a pile on the left bank underneath the bridge. No relation has yet been determined between the 1908 and 1909 gages; consequently estimates for 1908 are withheld.

Discharge measurements at the ferry location were made by wading. Measurements at the bridge location are either made from the bridge or by wading. The bed of the stream is of gravel and cobblestones and the flow is controlled by a riffle 200 feet below the gage.

Discharge measurements of Yakima River near Richland, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 3	H. Kimble	248	932	1.33	621
Sept. 7 [a]	C. F. Gleason	69	50	.25	50
Oct. 17	G. L. Parker	246	945	1.31	574

[a] Made by wading, 1,000 feet below gage.

Daily gage height, in feet, of Yakima River near Richland, Wash., for 1909.

[J. B. Clements, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	.....	0.30	0.96	11	0.98	0.20	1.10	21	0.50	0.58	1.25
2	.....	.30	.98	12	.95	.30	1.00	22	.40	.68	1.25
3	1.33	.30	1.00	13	.90	.30	1.10	23	.40	.78	1.20
4	1.33	.25	1.00	14	.90	.28	1.40	24	.40	.76	1.30
5	1.50	.30	1.15	15	.80	.35	1.30	25	.35	.80	1.25
6	1.10	.30	1.25	16	.80	.30	1.30	26	.30	.88	1.25
7	.98	.28	1.10	17	.70	.28	1.30	27	.35	.90	1.30
8	.98	.25	1.10	18	.70	.35	1.28	28	.50	.90	1.30
9	.96	.25	1.10	19	.50	.42	1.28	29	.50	.92	1.30
10	.93	.20	1.15	20	.50	.40	1.28	30	.50	1.00	1.30
								31	.40	.....	1.35

Daily discharge, in second-feet, of Yakima River near Richland, Wash., for 1909.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	.....	64	375	11	387	38	465	21	133	167	562
2	.....	64	387	12	368	64	400	22	96	215	562
3	614	64	400	13	337	64	465	23	96	268	530
4	614	51	400	14	337	59	660	24	96	257	595
5	725	64	498	15	279	80	595	25	80	279	562
6	465	64	562	16	279	64	595	26	64	325	562
7	387	59	465	17	225	59	595	27	80	337	595
8	387	51	465	18	225	80	582	28	133	337	595
9	375	51	465	19	133	103	582	29	133	350	595
10	356	38	498	20	133	96	582	30	133	400	595
								31	96	.....	628

NOTE.—These discharges are based on a fairly well-defined rating curve.

Monthly discharge of Yakima River near Richland, Wash., for 1909.

[Drainage area, 5,230 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth (in inches on drainage area).	Total in acre-feet.	
August 1-31	725	64	268	0.051	0.06	15,400	A.
September	400	38	140	.027	.03	8,330	A.
October	660	375	530	.101	.12	32,600	A.

CABIN CREEK NEAR EASTON, WASH.

This station was established May 12, 1909, at the Northern Pacific Railway bridge one-half mile above the mouth of the stream 2¾ miles west of Easton, Wash. The data are valuable in the general study of the Yakima River system to determine the amount of water contributed to Yakima River by Cabin Creek and run-off factors that can be applied to similar areas.

The gage is a vertical staff fixed to a piling on the right bank underneath the railroad bridge. Measurements are made from the bridge or by wading at low stages. There is an east channel whose waters do not pass the gage but this is measured and included in the discharge. The east channel is carried under the railroad embankment in a 42-inch iron pipe. The water is confined at all stages by the railroad embankment.

The bed of the stream is of gravel and subject to change during high stages. From a tributary of Cabin Creek above the station a 6-inch wooden pipe diverts water for locomotive use at Easton.

Discharge measurements of Cabin Creek near Easton, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	Stevens and McGlashan	36	54	2.63	196
June 5	H. D. McGlashan	38	105	3.03	423
July 22 [a]	H. Kimble	19	21	1.23	28
Oct. 5 [a]	do	18	14	.92	11
Nov. 17	C. F. Gleason	33	47	1.57	65

[a] Made by wading.

Daily gage height, in feet, of Cabin Creek near Easton, Wash., for 1909.

[Chris. Atkinson, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.62	1.95	1.10	0.80	1.00	2.00	2.30
2	.....	3.76	1.90	1.10	.79	1.00	3.00	2.20
3	.....	3.90	1.89	1.05	.78	1.00	3.10	2.10
4	.....	3.20	1.83	1.02	.76	.99	3.00	2.10
5	.....	3.12	1.90	1.00	.75	.98	2.50	2.10
6	.....	2.99	1.90	.99	.74	1.00	2.45	2.10
7	.....	2.82	1.72	.98	.73	1.10	2.30	2.10
8	.....	2.70	1.70	.98	.72	1.29	2.10	2.30
9	.....	2.70	1.69	.98	.71	1.30	2.00	2.95
10	.....	2.90	1.60	.98	.70	1.30	1.95	2.90
11	.....	3.00	1.62	.96	.71	1.20	1.90	2.60
12	2.63	2.92	1.55	.95	.72	1.20	1.80	2.50
13	2.62	2.72	1.51	.95	.72	1.19	1.70	2.50
14	2.61	2.60	1.50	.94	.71	1.15	1.60	2.50
15	2.62	2.61	1.45	.94	.71	1.10	1.50	2.50
16	2.59	2.60	1.43	.94	.70	1.10	1.50	2.45
17	2.59	2.50	1.42	.92	.70	1.00	1.80	2.45
18	2.59	2.43	1.42	.90	.70	1.00	1.80	2.40
19	2.65	2.40	1.40	.89	.70	1.01	1.90	2.40
20	2.70	2.40	1.35	.88	1.02	1.01	2.00	2.30
21	2.62	2.30	1.30	.86	1.04	1.00	2.00	2.20
22	2.60	2.20	1.28	.85	1.04	1.00	1.98	2.00
23	2.59	2.20	1.26	.84	1.03	1.03	1.96	2.00
24	2.67	2.10	1.20	.84	1.03	1.05	2.00	1.90
25	2.90	2.20	1.20	.84	1.01	1.04	3.90	1.90
26	3.22	2.10	1.19	.84	1.00	1.03	2.98	1.85
27	3.55	2.10	1.19	.84	.98	1.02	2.96	1.80
28	3.50	2.10	1.18	.84	.98	1.01	2.98	1.80
29	3.40	2.00	1.17	.83	1.00	1.00	2.98	1.80
30	3.20	1.95	1.16	.83	1.00	1.00	2.96	1.70
31	3.20	.....	1.15	.82	.....	1.00	.....	1.70

Daily discharge, in second-feet, of Cabin Creek near Easton, Wash., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	765	84	22	7.0	16	90	136
2	.....	873	79	22	6.6	16	360	120
3	.....	985	78	19	6.2	16	415	104
4	.....	475	72	17	5.4	16	360	104
5	.....	427	79	16	5.0	15	174	104
6	.....	355	79	16	4.6	16	164	104
7	.....	274	62	15	4.2	22	136	104
8	.....	230	60	15	3.8	33	104	136
9	.....	230	59	15	3.4	34	90	335
10	.....	310	53	15	3.0	34	84	310
11	.....	360	54	14	3.4	28	79	200
12	209	320	50	14	3.8	28	69	174
13	206	237	47	14	3.8	27	60	174
14	203	200	46	13	3.4	25	53	174
15	206	203	43	13	3.4	22	46	174
16	197	200	42	13	3.0	22	46	164
17	197	174	41	12	3.0	16	69	164
18	197	160	41	11	3.0	16	69	154
19	215	154	40	11	3.0	17	79	154
20	230	154	37	10	17	17	90	136
21	206	136	34	9.4	18	16	90	120
22	200	120	33	9.0	18	16	88	90
23	197	120	32	8.6	18	18	86	90
24	221	104	28	8.6	18	19	90	79
25	310	120	28	8.6	17	18	985	79
26	488	104	27	8.6	16	18	350	74
27	715	104	27	8.6	15	17	340	69
28	680	104	27	8.6	15	17	350	69
29	610	90	26	8.2	16	16	350	69
30	475	84	26	8.2	16	16	340	60
31	475	.....	25	7.8	.....	16	.....	60

NOTE.—These discharges are based on a rating curve that is fairly well defined between discharges of 11 and 420 second-feet.

Monthly discharge of Cabin Creek near Easton, Wash., for 1909.

[Drainage area, 32 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
May 12-31	715	197	322	10.1	7.51	12,800	B.
June	985	84	272	8.50	9.48	16,200	B.
July	84	25	47.1	1.47	1.70	2,900	A.
August	22	7.8	12.6	.394	.45	775	B.
September	18	3.0	8.77	.274	.31	522	C.
October	34	15	20.1	.628	.72	1,240	B.
November	985	46	190	5.94	6.63	11,300	B.
December	335	60	132	4.12	4.75	8,120	B.
The period						53,900	

KACHESS LAKE NEAR EASTON, WASH.

Kachess Lake is divided into two parts, known as Kachess and Little Kachess, which are connected by a short channel called The Narrows. The elevation of the water surface is 2,230 feet and the superficial area at the medium stage is 3,600 acres. A gage was established in Kachess Lake September 20, 1905. It is located about 300 feet above the dam at the outlet. The gage datum in this lake is at an elevation of 2,227.02 feet and has not been changed since the gage was installed.

Daily gage height, in feet, of Kachess Lake near Easton, Wash., for 1909.

[H. A. Shandy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.00	0.78	0.78	1.20	2.15	3.58	5.38	5.48	2.01	0.60	0.40	5.80
2	1.00	.77	.80	1.25	2.25	3.98	5.32	5.47	1.82	.59	.75	5.48
3	1.00	.74	.78	1.30	2.25	4.20	5.32	5.45	1.70	.58	1.55	5.00
4	.98	.70	.79	1.30	2.50	4.38	5.30	5.44	1.55	.57	2.30	4.75
5	.95	.70	.79	1.29	2.75	4.35	5.30	5.42	1.40	.55	2.60	4.35
6	.90	.72	.79	1.30	2.80	.430	5.20	5.39	1.30	.55	2.55	4.05
7	.88	.74	.78	1.32	2.78	4.15	5.20	5.38	1.20	.58	2.48	3.75
8	.87	.74	.80	1.31	2.75	4.08	5.20	5.36	1.15	.56	2.44	3.50
9	.86	.74	.80	1.35	2.70	3.98	5.25	5.33	1.10	.55	2.40	3.20
10	.85	.73	.78	1.35	2.70	3.98	5.30	5.30	1.05	.53	2.35	3.05
11	.84	.71	.78	1.38	2.66	3.98	5.38	5.27	1.00	.51	2.20	2.90
12	.83	.69	.75	1.40	2.60	4.00	5.48	5.24	.93	.50	2.10	2.95
13	.82	.66	.70	1.45	2.45	3.98	5.45	5.15	.88	.50	2.00	3.10
14	.80	.64	.68	1.50	2.51	3.96	5.45	5.03	.85	.49	1.90	3.00
15	.80	.60	.68	1.54	2.52	3.80	5.45	4.90	.80	.48	1.81	2.85
16	.78	.80	.68	1.58	2.55	3.80	5.45	4.75	.74	.47	1.71	2.75
17	.75	.02	.68	1.58	2.57	3.70	5.45	4.48	.71	.46	1.60	2.60
18	.80	.85	.72	1.56	2.58	3.71	5.47	4.31	.68	.44	1.85	2.50
19	1.00	.85	.75	1.56	2.65	3.80	5.48	4.10	.64	.42	2.42	2.40
20	1.00	.87	.75	1.56	2.65	3.90	5.49	3.98	.64	.42	3.15	2.30
21	1.00	.86	.74	1.56	2.64	3.88	5.49	3.89	.75	.42	3.22	2.20
22	1.00	.84	.75	1.56	2.62	4.18	5.49	3.76	.75	.41	3.30	2.15
23	1.00	.82	.77	1.56	2.60	4.36	5.49	3.60	.70	.41	4.40	2.08
24	1.00	.80	.78	1.59	2.60	4.51	5.49	3.40	.68	.40	5.80	2.00
25	.94	.80	.78	1.59	2.70	4.79	5.49	3.20	.68	.40	6.00	1.90
26	.90	.79	.77	1.81	2.89	4.98	5.49	2.99	.67	.39	5.50	1.85
27	.90	.79	.80	2.00	3.08	5.20	5.49	2.80	.63	.39	5.10	1.70
28	.88	.80	.87	2.00	3.25	5.30	5.49	2.68	.61	.38	4.80	1.65
29	.85	.....	.95	2.15	3.35	5.35	5.50	2.50	.61	.38	4.90	1.63
30	.83	.....	1.05	2.10	3.35	5.38	5.50	2.36	.62	.38	6.00	1.60
31	.82	.....	1.15	.....	3.38	.....	5.49	2.22	.....	.39	.....	1.58

Table showing volume of storage on Kachess Lake near Easton, Wash., for 1909.

Gage height.	Storage.	Gage height.	Storage.	Gage height.	Storage.
Feet.	*Acre-feet.*	*Feet.*	*Acre-feet.*	*Feet.*	*Acre-feet.*
0.00	0	3.00	10,500	6.00	21,100
1.00	3,500	4.00	14,000	7.00	24,700
2.00	7,000	5.00	17,500	8.00	28,400

NOTE.—This table has been used in determining the amount of water stored in or drawn from the lake, and in connection with the records on Kachess River, to compute the inflow into the lake. This table differs slightly from that published in Water-Supply Paper 252. It is, however, the same as used by the United States Reclamation Service.

KACHESS RIVER NEAR EASTON, WASH.

This station was established October 14, 1903. It is located half a mile below the outlet of Kachess Lake and 2 miles northwest of Easton. The river receives no important tributaries.

The records determine the amount of water available for storage in Kachess Lake, which forms one of the principal reservoirs under consideration by the United States Reclamation Service.

The flow is under artificial control, the lake being used for storage by the Cascade Canal Co. prior to its acquisition by the United States Reclamation Service.

The channel is open throughout the year at this point. The current is swift and ice does not form. The channel conditions at the station are not favorable for a high degree of accuracy. The bed is composed of gravel and cobblestones and at low stages it is difficult to measure depths accurately.

The datum of the inclined staff gage, which is 2,178.41 feet above sea level, has not been altered since it was established, and except for slight modifications at the low stages a single discharge curve was used up to and including 1908. High-water measurements in 1909 indicated that the high-water portion of the curve gave too large discharges, so it has been modified somewhat for 1909 to better equalize these later measurements. Discharge measurements are made from a cable equipment at the gage.

Discharge measurements of Kachess River near Easton, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 21	L. R. Allen	67	88	3.66	146
May 13	Stevens and McGlashan	73	176	4.83	478
June 4	H. D. McGlashan	79	287	6.20	1,010
July 21	H. Kimble	66	85.5	3.57	141
Sept. 17	C. F. Gleason	58	71	3.45	100
Nov. 7	H. Kimble	73	177	4.80	446

Daily gage height, in feet, of Kachess River near Easton, Wash., for 1909.

[H. A. Shandy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.65	3.51	3.53	3.78	4.51	5.05	4.65	3.41	4.18	3.40	3.29	7.20
2	3.65	3.50	3.55	3.83	4.61	6.00	4.60	3.40	4.20	3.40	3.53	7.00
3	3.65	3.48	3.53	3.85	4.61	6.15	4.60	3.41	4.19	3.40	4.10	6.60
4	3.64	3.46	3.54	3.85	4.81	6.20	4.59	3.40	4.10	3.39	4.85	6.45
5	3.62	3.46	3.54	3.84	5.01	6.15	4.50	3.41	4.00	3.38	4.90	6.20
6	3.60	3.47	3.54	3.85	5.06	6.15	4.50	3.41	3.95	3.38	4.85	6.00
7	3.59	3.48	3.54	3.86	5.03	6.05	4.40	3.40	3.84	3.39	4.80	5.75
8	3.59	3.48	3.55	3.85	5.01	6.00	4.40	3.40	3.80	3.38	4.75	5.55
9	3.58	3.48	3.55	3.89	4.98	5.90	3.50	3.40	3.75	3.37	4.70	5.40
10	3.58	3.47	3.53	3.89	4.98	5.90	3.50	3.39	3.70	3.36	4.61	5.30
11	3.57	3.45	3.53	3.90	4.96	5.90	3.53	3.40	3.62	3.35	4.52	5.25
12	3.57	3.44	3.50	3.91	4.92	5.95	3.80	3.40	3.55	3.35	4.48	5.25
13	3.56	3.42	3.47	3.96	4.80	5.90	4.00	3.81	3.50	3.35	4.40	5.40
14	3.54	3.40	3.45	4.00	4.83	5.82	4.00	3.79	3.48	3.34	4.30	5.35
15	3.52	3.37	3.45	4.02	4.84	5.82	3.80	4.40	3.46	3.34	4.22	5.20
16	3.50	3.47	3.45	4.05	4.86	5.82	3.60	4.40	3.45	3.33	4.17	5.15
17	3.48	3.56	3.45	4.05	4.86	5.75	3.60	4.41	3.45	3.33	4.12	5.00
18	3.52	3.58	3.47	4.03	4.88	5.20	3.58	4.76	3.43	3.32	4.30	4.95
19	3.65	3.58	3.50	4.03	4.93	4.75	3.58	4.75	3.40	3.30	4.72	4.80
20	3.65	3.60	3.50	4.03	4.93	4.58	3.60	4.37	3.40	3.30	5.43	4.70
21	3.65	3.58	3.47	4.03	4.92	4.60	3.60	4.05	3.52	3.30	5.48	4.60
22	3.65	3.56	3.49	4.03	4.91	3.15	3.59	4.40	3.52	3.30	5.58	4.50
23	3.65	3.55	3.50	4.03	4.90	3.15	3.59	4.39	3.48	3.30	6.48	4.40
24	3.65	3.54	3.51	4.05	4.90	3.16	3.59	4.40	3.45	3.29	7.30	4.34
25	3.62	3.54	3.51	4.05	4.97	3.20	3.45	4.40	3.45	3.29	7.50	4.27
26	3.60	3.53	3.50	4.19	5.10	3.30	3.45	4.39	3.45	3.28	7.00	4.22
27	3.60	3.53	3.53	4.40	5.28	3.50	3.30	4.38	3.40	3.28	6.70	4.18
28	3.59	3.55	3.56	4.40	5.41	3.60	3.20	4.40	3.40	3.28	6.50	4.13
29	3.55	.....	3.62	4.51	5.50	3.90	3.20	4.20	3.40	3.27	6.60	4.11
30	3.54	.....	3.70	4.48	5.55	4.70	3.21	4.19	3.42	3.27	7.50	4.09
31	3.52	.....	3.78	.....	5.57	.....	3.42	4.20	.....	3.28	.....	4.08

Daily discharge, in second-feet, of Kachess River near Easton, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	146	117	121	175	366	776	412	99	270	97	81	1,580
2	146	115	126	186	398	920	395	97	275	97	121	1,460
3	146	111	121	190	398	990	395	99	272	97	249	1,220
4	144	108	123	190	465	1,020	392	97	249	96	479	1,140
5	140	108	123	188	534	990	363	99	224	94	496	1,020
6	136	110	123	190	552	990	363	99	212	94	479	920
7	134	111	123	192	541	942	333	97	188	96	462	816
8	134	111	126	190	534	920	333	97	179	94	445	736
9	132	111	126	199	523	878	115	97	168	92	428	678
10	132	110	121	199	523	878	115	96	157	91	398	640
11	130	106	121	201	516	878	121	97	140	90	369	621
12	130	104	115	203	503	899	179	97	126	90	357	621
13	128	101	110	215	462	878	224	181	115	90	333	678
14	123	97	106	224	472	844	224	177	111	88	303	659
15	119	92	106	229	476	844	179	333	108	88	281	602
16	115	110	106	236	482	844	136	333	106	86	267	584
17	111	128	106	236	482	816	136	336	106	86	254	530
18	119	132	110	232	489	602	132	448	102	85	303	513
19	146	132	115	232	506	445	132	445	97	82	435	462
20	146	136	115	232	506	389	136	324	97	82	689	428
21	146	132	110	232	503	395	136	236	119	82	708	395
22	146	128	113	232	499	64	134	333	119	82	748	363
23	146	126	115	232	496	64	134	330	111	82	1,160	333
24	146	123	117	236	496	65	134	333	106	81	1,650	315
25	140	123	117	236	520	69	106	333	106	81	1,790	295
26	136	121	115	272	566	82	106	330	106	79	1,460	281
27	136	121	121	333	632	115	82	327	97	79	1,280	270
28	134	126	128	333	682	136	69	333	97	79	1,170	257
29	126	.....	140	366	716	201	69	275	97	78	1,220	252
30	123	.....	157	357	736	428	70	272	101	78	1,790	246
31	119	.....	175	.....	744	.....	101	275	.....	79	.....	244

NOTE.—These discharges are based on a rating curve that is well defined between 100 and 1,020 second-feet.

Monthly discharge of Kachess River near Easton, Wash., for 1909.

[Drainage area, 63 square miles.]

Month.	Observed discharge in second-feet.			Run-off in acre-feet.			Discharge without storage in second-feet.		Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	Mean.	Mean. per square mile.		
January	146	111	134	8,240	− 630	7,610	124	1.97	2.27	B.
February	136	92	116	6,440	− 70	6,370	115	1.83	1.91	B.
March	175	106	121	7,440	+ 1,220	8,660	141	2.24	2.58	B.
April	366	175	232	13,800	+ 3,320	17,100	287	4.56	5.09	A.
May	744	366	526	32,300	+ 4,480	36,800	599	9.51	10.96	A.
June	1,020	64	612	36,400	+ 7,040	43,400	730	11.6	12.94	A.
July	412	69	192	11,800	+ 396	12,200	198	3.14	3.62	A.
August	448	96	230	14,100	−11,500	2,600	42.3	.671	0.77	A.
September	275	97	145	8,630	− 5,600	3,030	51.0	.810	0.90	B.
October	97	78	86.9	5,340	− 805	4,540	73.9	1.17	1.35	B.
November	1,790	81	674	40,100	+19,700	59,800	1,000	15.9	17.74	A.
December	1,580	244	618	38,000	−15,600	22,400	364	5.78	6.66	A.
The year	1,790	64	307	223,000	.....	225,000	310	4.93	66.79	

BIG CREEK NEAR CLEALUM, WASH.

This station, which is located 10 miles west of Clealum, Wash., about 4 miles east of Easton, Wash., 1 mile above the highway crossing of Big Creek and 50 feet above the head of the Diener ditch, the uppermost diversion from this stream, was established May 12, 1909, to determine the amount of water contributed by Big Creek to Yakima River. It was also expected that certain run-off factors would be secured that would be applicable on Little Creek, the next tributary upstream from Big Creek, but owing to poor records after June 9, caused by ditch diversion, the purpose has not yet been satisfactorily accomplished.

The gage is a vertical staff fixed to the root of a large tree on the right bank. Measurements are made by wading at the riffle 30 feet below the gage. The banks of the stream are heavily wooded and subject to overflow in high stages. The bed of the stream is of gravel and sand but the flow is controlled by the riffle.

Observations at this station were suspended September 1, 1909, for lack of an observer.

Discharge measurements of Big Creek near Clealum, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 12	Stevens and McGlashan	38	50	1.63	127
June 4 [a]	H. D. McGlashan	38	60	2.19	246
July 23 [b]	H. Kimble	21	7.7	.58	18.3
Oct. 4 [c]	.....do	20	7.2	.42	12.5
Nov. 18 [c]	.....do	30	21	1.05	61.7

[a] Measurement not made at regular section.
[b] Made by wading opposite gage.
[c] Made by wading just below gage.

Daily gage height, in feet, and discharge, in second-feet, of Big Creek near Clealum, Wash., for 1909.

[Angelena Massano, observer.]

Day.	May.		June.		Day.	May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1					16	1.80	162		
2					17	2.03	202		
3			2.50	290	18	1.92	183		
4			2.11	217	19	2.11	217		
5			2.04	204	20	1.92	183		
6			2.02	201	21	2.30	252		
7			2.15	224	22	1.85	170		
8			1.98	193	23	1.81	164		
9			1.72	149	24	2.03	202		
10					25	2.03	202		
11					26	2.40	271		
12	1.63	135			27	3.03	396		
13	1.81	164			28	2.38	267		
14	1.80	162			29	2.15	224		
15	1.93	184			30	2.17	228		
					31	3.05	400		

NOTE.—The gage observer reported the water as above the gage on June 1 and 2. The above daily discharges were obtained from a fairly well-defined rating curve.

CLEALUM LAKE NEAR ROSLYN, WASH.

Observations of heights of Clealum Lake were begun January 25, 1906.

The first gage was used until March 31, 1906, when it was destroyed by waves. The gage was not referred to a bench mark and the datum is lost for that period. The gage heights reported are therefore not comparable with subsequent records. Gage No. 2 was installed May 4, 1906. It is located above the outlet of the lake. The zero of the gage is at an elevation of 2,122.30 feet above sea level, United States Geological Survey datum. During the winter of 1907–8 a temporary crib dam was constructed 200 feet below the outlet of the lake.

On June 17, 1907, gage No. 3 was fixed to the abutment of this dam. The zero of this gage coincides with the top of the sill of the outlet tunnels in the dam at an elevation of 2,122.75 feet above sea level, United States Geological Survey datum.

Between the outlet of the lake and the dam there is some fall to the water surface when the lake stage is below 6 feet, which increases as the stage decreases. Prior to March 15, 1908, while the dam was under construction, the heights observed on gage No. 3 are not comparable with those formerly obtained on gage No. 2. Since the latter date the water has been maintained at a sufficient height to obliterate the fall between the two gages. During 1908 a correction of 0.45 foot was added to heights observed on gage No. 3 to make them comparable with those on No. 2, but for 1909 this correction has not been made. To render the 1908 records from gage No. 3 comparable

with those of 1909 and subsequent years, 0.45 foot should be subtracted from them.

Gage No. 5, installed during 1909, is above the outlet of the lake and will not be affected by the fall between the outlet and the dam at low stages.

When the lake surface is drawn down sufficiently to develop an appreciable current between the lake and the dam, gage No. 5 is read; at other times gage No. 3, which is not affected by wave action on the lake, is read; gage No. 4 is an auxiliary gage at the dam, reading from the same datum as gages Nos. 3 and 5. It is in a stilling box in order to indicate the heights with a greater degree of accuracy.

Daily gage heights, in feet, of Clealum Lake near Roslyn, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	11.9	11.8	11.7	12.3	12.6	14.0	12.80	10.90	3.22	3.25	2.93	14.60
2	11.9	11.8	11.7	12.3	12.7	14.8	12.90	9.72	3.21	3.24	3.30	13.87
3	11.9	11.8	11.7	12.3	13.0	15.3	12.90	9.36	3.19	3.23	5.10	13.20
4	11.9	11.8	11.7	12.2	13.6	14.7	12.90	8.88	3.19	3.18	7.45	12.10
5	11.9	11.7	11.7	12.2	13.7	14.3	12.90	8.52	3.19	3.11	8.41	12.10
6	11.9	11.7	11.7	12.2	13.4	14.0	12.90	8.09	3.19	3.08	8.65	12.08
7	11.8	1..7	11.7	12.1	13.1	13.9	12.80	7.70	3.18	3.10	8.62	12.05
8	11.8	11.7	11.7	12.1	12.9	13.8	12.80	7.38	3.18	3.06	8.45	11.95
9	11.8	11.6	11.7	12.1	12.9	13.8	12.78	6.84	3.18	3.08	8.28	11.85
10	11.8	11.6	11.6	12.1	12.9	13.9	12.71	6.50	3.18	3.10	8.05	11.75
11	11.8	11.6	11.6	12.2	12.9	14.0	12.72	6.00	3.14	3.15	7.78	11.65
12	11.8	11.6	11.6	12.3	12.8	14.1	12.70	5.50	3.02	3.20	7.50	11.75
13	11.7	11.6	11.6	12.4	12.8	14.0	12.60	5.02	2.98	3.20	7.30	12.25
14	11.7	11.6	11.6	12.5	13.0	13.8	12.50	4.88	2.94	3.20	6.80	12.30
15	11.7	11.6	11.7	12.7	13.1	13.7	12.50	4.51	2.88	3.18	6.30	12.15
16	11.7	11.7	11.7	12.7	13.2	13.8	12.40	4.30	2.83	3.14	6.04	12.00
17	11.8	11.8	11.8	12.7	13.2	13.7	12.40	4.16	2.80	3.14	5.88	11.85
18	11.9	11.8	11.8	12.6	13.2	13.6	12.40	3.88	2.78	3.12	5.70	11.75
19	11.9	11.8	11.9	12.5	13.3	13.5	12.30	3.78	2.78	3.02	8.13	11.65
20	11.9	11.8	11.9	12.5	13.3	13.5	12.20	3.64	2.88	2.97	9.72	11.50
21	11.9	11.8	11.9	12.5	13.2	13.5	12.20	3.59	3.06	2.92	11.40	11.40
22	11.9	11.8	11.9	12.5	13.1	13.4	12.10	3.49	3.15	2.88	12.10	11.30
23	11.9	11.7	11.9	12.5	13.1	13.3	11.90	3.45	3.17	2.85	14.80	11.15
24	11.9	11.7	11.9	12.6	13.2	13.2	11.82	3.36	3.17	2.85	16.70	10.95
25	11.9	11.7	11.9	12.7	13.4	13.1	11.68	3.25	3.19	2.86	15.10	10.80
26	11.9	11.7	12.0	12.9	13.8	13.0	11.50	3.21	3.17	2.88	13.90	10.60
27	11.9	11.7	12.1	13.0	14.0	13.0	11.20	3.30	3.14	2.88	13.20	10.45
28	11.8	11.7	12.2	12.9	14.0	13.0	11.14	3.32	3.10	2.90	12.90	10.15
29	11.8	.....	12.3	12.8	13.9	12.9	10.87	3.35	3.13	2.88	13.50	9.65
30	11.8	.....	12.3	12.7	13.6	12.8	10.60	3.32	3.18	2.88	16.20	9.35
31	11.8	.....	12.3	.....	13.6	.....	10.32	3.27	.....	2.88	.....	9.00

NOTE.—These gage heights are from gages which are 0.45 foot higher in elevation than the gage used in 1908. No correction for fall is necessary, as in 1908, in computing lake storage.

Volume of storage on Clealum Lake near Roslyn, Wash., for 1909.

Gage height.	Storage.	Gage height.	Storage.	Gage height.	Storage.	Gage height.	Storage.
Feet.	*Acre-feet.*	*Feet.*	*Acre-feet.*	*Feet.*	*Acre-feet.*	*Feet.*	*Acre-feet.*
1.00	1,700	5.00	9,600	9.00	18,600	13.00	28,100
2.00	3.600	6.00	11,800	10.00	20,900	14.00	30,500
3.00	5,500	7.00	14,000	11.00	23,300	15.00	33,000
4.00	7,500	8.00	16,300	12.00	25,700	16.00	35,500

NOTE.—This table has been used to determine the amount of water in, or drawn from, the lake, and in connection with the records on Clealum River, to compute the inflow into the lake. This table differs slightly from that published in Water-Supply Paper 252. It is, however, the same as used by the United States Reclamation Service.

CLEALUM RIVER NEAR ROSLYN, WASH.

This station was established October 10, 1903, to obtain data for use in connection with the development of irrigation in the Yakima Valley. It is located below the outlet of Clealum Lake, which is to be utilized for storage by the United States Reclamation Service.

The inclined staff gage is 1,000 feet below the outlet of the lake, about 2½ miles northwest of Roslyn, Wash. It is about 500 feet above the cable from which discharge measurements are made.

The conditions at the station are favorable for good results and a permanent rating curve has been developed. There was a little dead water at low stages, but this difficulty has been removed by relocation of the cable on August 20, 1908, about 500 feet below the former site. The datum of the gage has remained constant since the station was established. Ice does not interfere with the determination of flow during the winter months.

During the winter of 1907 the Reclamation Service completed a temporary timber dam for storage. The outflow of the lake is therefore under artificial control.

Before the dam was constructed the lake was used for storage by the Cascade Lumber Co., and the flow during the summer months was therefore partially under control, although the dam was of temporary construction and was replaced each season.

Discharge measurements of Clealum River near Roslyn, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 20	L. R. Allen	127	290	1.84	288
May 14	Stevens and McGlashan	135	639	4.43	1,710
June 3	H. D. McGlashan	151	1,100	7.50	5,130
July 23 [a]	H. Kimble	133	470	3.06	797
Sept. 18	C. F. Gleason	131	258	1.45	218
Oct. 7	H. Kimble	132	286	1.75	283
Nov. 4	do	134	546	3.80	1,180
Dec. 1 [b]	Gleason and Kimble	150	1,110	7.95	5,630

[a] One flash board removed from dam during the measurement.
[b] Gage height at this stage is not an index of area.

Daily gage height, in feet, of Clealum River near Roslyn, Wash., for 1909.

[A. D. Nichols, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	1.5	1.6	3.00	3.72	6.10	4.02	3.25	1.84	1.90	1.65	8.30
2	1.7	1.5	1.6	3.00	3.96	7.50	4.04	3.25	1.82	1.88	1.90	6.40
3	1.7	1.5	1.5	2.90	4.42	7.70	4.16	3.26	1.80	1.85	2.95	5.30
4	1.8	1.5	1.5	2.80	5.36	7.10	4.20	3.26	1.80	1.83	3.72	4.60
5	1.7	1.5	1.5	2.70	5.64	6.50	4.20	3.25	1.80	1.80	3.90	4.20
6	1.7	1.5	1.5	2.70	5.04	6.20	4.14	3.18	1.80	1.76	3.95	4.00
7	1.7	1.5	1.5	2.60	4.54	5.84	4.04	3.10	1.80	1.78	3.75	3.94
8	1.6	1.5	1.5	2.60	4.24	5.64	3.90	3.10	1.80	1.76	3.70	3.48
9	1.6	1.5	1.5	2.70	4.16	5.60	3.82	3.10	1.80	1.78	3.63	3.36
10	1.6	1.5	1.5	2.82	4.18	5.84	3.76	3.10	1.79	1.79	3.60	3.22

Daily gage height, in feet, of Clealum River near Roslyn, Wash., for 1909—Cont'd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1.6	1.5	1.4	2.96	4.14	6.12	3.78	3.10	1.77	1.82	3.58	3.10
12	1.5	1.4	1.4	3.18	4.02	6.30	3.76	3.10	1.70	1.84	3.52	3.25
13	1.5	1.4	1.4	3.44	4.04	6.20	3.60	2.98	1.65	1.84	3.45	3.87
14	1.5	1.4	1.5	3.68	4.36	5.62	3.42	2.78	1.62	1.84	3.38	3.96
15	1.5	1.5	1.6	3.76	4.60	5.64	3.30	2.63	1.60	1.80	3.30	3.78
16	1.5	1.6	1.7	3.72	4.80	5.82	3.26	2.52	1.58	1.76	3.22	3.59
17	1.6	1.7	1.8	3.54	4.82	5.64	3.24	2.35	1.55	1.76	3.12	3.40
18	1.6	1.8	1.9	3.40	4.86	5.32	3.14	2.28	1.51	1.73	3.05	3.26
19	1.7	1.8	2.0	3.32	4.94	5.24	3.02	2.21	1.51	1.69	3.54	3.09
20	1.8	1.8	2.0	3.36	4.96	5.28	2.86	2.12	1.58	1.65	3.93	2.97
21	1.9	1.7	2.0	3.32	4.72	5.10	2.80	2.08	1.66	1.62	4.13	2.88
22	1.9	1.7	2.0	3.30	4.54	4.92	3.20	2.02	1.77	1.60	4.73	2.84
23	1.9	1.7	2.0	3.42	4.42	4.80	3.20	1.96	1.80	1.58	8.00	2.80
24	1.8	1.7	2.0	3.62	4.70	4.52	3.18	1.91	1.80	1.58	10.50	2.78
25	1.8	1.7	2.0	3.74	5.24	4.36	3.15	1.87	1.83	1.59	8.30	[a] 2.79
26	1.7	1.6	2.2	4.14	5.82	4.24	3.23	1.82	1.81	1.61	6.50	[a] 2.78
27	1.7	1.6	2.4	4.36	6.12	4.34	3.19	1.88	1.78	1.61	5.40	2.72
28	1.6	1.6	2.6	4.22	6.24	4.34	3.10	1.94	1.76	1.62	4.90	[a] 2.86
29	1.6	.....	2.9	4.20	5.90	4.14	3.19	1.91	1.79	1.60	6.00	3.08
30	1.5	.....	3.0	3.82	5.52	4.02	3.22	1.88	1.83	1.59	10.10	[a] 3.05
31	1.5	.....	3.0	.....	5.42	.....	3.25	1.86	.....	1.59	.....	3.09

[a] Flash boards changed.

NOTE.—Slight ice conditions existed during the winter months, but probably did not affect results.

Daily discharge, in second-feet, of Clealum River near Roslyn, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	260	200	230	730	1,130	3,280	1,330	862	302	320	245	6,220
2	260	200	230	730	1,290	5,100	1,350	862	296	314	320	3,640
3	260	200	200	685	1,610	5,380	1,430	868	290	305	708	2,400
4	290	200	200	645	2,460	4,540	1,460	868	290	299	1,130	1,750
5	260	200	200	605	2,750	3,760	1,460	862	290	290	1,250	1,460
6	260	200	200	605	2,140	3,460	1,420	824	290	278	1,280	1,320
7	260	200	200	565	1,700	2,970	1,350	780	290	284	1,150	1,280
8	230	200	200	565	1,490	2,750	1,250	780	290	278	1,120	989
9	230	200	200	605	1,430	2,710	1,190	780	290	284	1,080	923
10	230	200	200	653	1,450	2,970	1,160	780	287	287	1,060	846
11	230	200	175	712	1,420	3,300	1,170	780	281	296	1,050	780
12	200	175	175	824	1,330	3,520	1,160	780	260	302	1,010	862
13	200	175	175	967	1,350	3,400	1,060	721	245	302	972	1,230
14	200	175	200	1,110	1,570	2,730	956	637	236	302	934	1,290
15	200	200	230	1,160	1,750	2,750	890	577	230	290	890	1,170
16	200	230	260	1,130	1,920	2,950	868	533	224	278	846	1,050
17	230	260	290	1,020	1,940	2,750	897	472	215	278	791	945
18	230	290	320	945	1,970	2,420	802	348	203	269	755	868
19	260	290	350	901	2,050	2,340	740	424	203	257	1,020	775
20	290	290	350	923	2,060	2,380	669	392	224	245	1,270	716
21	320	260	350	901	1,850	2,200	645	378	248	236	1,410	677
22	320	260	350	890	1,700	2,030	835	357	281	230	1,860	661
23	320	260	350	956	1,610	1,920	835	338	290	224	5,800	645
24	290	260	350	1,070	1,830	1,690	824	323	290	224	9,940	637
25	290	260	350	1,140	2,340	1,670	808	311	299	227	6,220	641
26	260	230	420	1,420	2,950	1,490	852	296	293	233	3,760	637
27	260	230	490	1,570	3,300	1,560	830	314	284	233	2,500	613
28	230	230	565	1,470	3,450	1,560	780	332	278	236	2,010	669
29	230	.....	685	1,460	3,040	1,420	830	323	287	230	3,160	770
30	200	.....	730	1,190	2,620	1,330	846	314	299	227	9,220	755
31	200	.....	730	.....	2,520	.....	862	308	.....	227	.....	775

NOTE.—These discharges were obtained from a fairly well-defined rating curve. Above a discharge of 4,400 second-feet it is the same as for 1906 to 1908.

Monthly discharge of Clealum River near Roslyn, Wash., for 1909.

[Drainage area, 205 square miles.]

Month.	Observed discharge in second-feet.			Run-off in acre-feet.			Discharge without storage, in second-feet.		Run-off (depth in inches on drainage area).	Accuracy.
	Maximum.	Minimum.	Mean.	Observed.	Stored.	Without storage.	Mean.	Mean per square mile.		
January	320	200	248	15,200	− 240	15,000	244	1.19	1.37	B.
February	290	175	224	12,400	− 240	12,200	220	1.07	1.11	B.
March	730	175	321	19,700	+ 1,440	21,100	343	1.67	1.92	B.
April	1,570	565	938	55,800	+ 960	56,800	954	4.65	5.19	B.
May	3,450	1,130	2,000	123,000	+ 2,400	125,000	2,030	9.90	11.41	A.
June	5,380	1,330	2,740	163,000	− 2,880	160,000	2,690	13.1	14.62	A.
July	1,460	645	1,020	62,700	− 5,950	56,800	924	4.51	5.20	A.
August	862	296	556	34,200	−17,000	17,200	280	1.37	1.58	B.
September	302	203	270	16,100	− 80	16,000	269	1.31	1.46	B.
October	320	224	267	16,400	− 728	15,700	256	1.25	1.44	B.
November	9,940	245	2,160	129,000	+50,600	180,000	3,020	14.7	16.40	A.
December	6,220	613	1,230	75,600	−13,400	62,200	1,010	4.93	5.68	A.
The year	9,940	175	998	723,000	.....	738,000	1,020	4.97	67.38	

TEANAWAY RIVER NEAR CLEALUM, WASH.

This station, which is located at the lower Teanaway highway bridge 4½ miles southeast of Clealum, Wash., about half a mile above the mouth and below all diversions for irrigation, was established April 2, 1909, to determine the amount of water contributed to Yakima River from the Teanaway drainage area.

A number of important ditches take water above the station for irrigation, and it was impossible to select a site above them. As the stream is used extensively for floating logs during the spring months the estimates are subject to errors from the unknown effects of backwater caused by logs in the channel. Some unusual fluctuations in the discharge are also caused by water for log driving released daily from the splash dams on the forks of the stream 20 miles above the station.

The chain gage is fixed to the downstream side of the bridge from which measurements are made. The right bank is high and of cemented gravel; the left bank is low and wooded and subject to overflow during high stages. The bed of the stream is of hard clay and gravel and is not likely to change.

Discharge measurements of Teanaway River near Clealum, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	Stevens and McGlashan	109	200	4.69	854
June 16	H. D. McGlashan	103	177	4.42	683
July 24[a]	H. Kimble	35.6	33.5	2.81	34.9
Oct. 4[a]	do	57	45	2.85	49
Nov. 4	do	113	206	4.80	913
24	do	117	455	7.00	3,630

[a] Made by wading.

Daily gage height, in feet, of Teanaway River near Clealum, Wash., for 1909.

[Athene Clymer, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.48	5.05	3.40	2.86	2.33	2.94	2.87	5.50
2	3.86	4.64	5.41	3.36	2.74	2.32	2.92	3.41	4.95
3	3.63	5.40	5.12	3.33	2.70	2.26	2.88	5.60	4.45
4	3.70	5.50	4.80	3.30	2.66	2.27	2.86	4.80	4.07
5	3.91	5.33	4.70	3.28	2.60	2.28	2.82	.....	3.98
6	3.57	4.67	4.53	3.28	2.58	2.27	2.83	.....	3.76
7	3.44	4.46	4.39	3.33	2.52	2.26	2.83	.....	3.61
8	3.90	4.45	4.30	3.29	2.50	2.25	2.84	3.68	3.50
9	4.60	4.47	4.22	3.25	2.47	2.26	2.82	3.72	3.50
10	4.52	4.46	4.29	3.20	2.35	2.30	2.85	3.70	3.39
11	4.28	4.38	4.37	3.28	2.43	2.31	2.82	3.62	3.33
12	4.35	4.34	4.37	3.17	2.42	2.30	2.84	3.53	3.77
13	4.79	4.37	4.24	3.24	2.38	2.30	2.82	3.49	4.01
14	4.97	4.73	4.10	3.10	2.32	2.29	2.80	3.52	3.82
15	4.58	4.65	4.15	3.09	2.39	2.29	2.78	3.30	3.67
16	4.38	4.60	4.14	3.05	2.31	2.26	2.77	3.26	3.52
17	4.23	4.62	4.03	3.03	2.30	2.25	2.78	3.29	3.38
18	4.37	4.56	3.98	3.02	2.32	2.24	2.77	3.55	3.43
19	4.17	4.67	3.95	2.98	2.40	2.23	2.77	5.40	3.44
20	4.48	4.55	3.88	2.92	2.42	2.28	2.77	4.80	3.22
21	4.38	4.46	3.86	2.90	2.46	2.31	2.80	4.40	3.06
22	4.30	4.41	3.76	2.96	2.41	2.32	2.84	4.26	2.98
23	4.67	4.39	3.70	2.85	2.42	2.31	2.83	6.80	2.96
24	4.73	4.56	3.63	2.81	2.41	2.33	2.83	6.90	3.05
25	4.50	4.82	3.58	2.77	2.38	2.42	2.83	5.60	3.16
26	5.05	5.17	3.59	2.80	2.40	2.65	2.82	4.77	3.24
27	4.88	5.14	3.55	2.80	2.34	2.65	2.82	4.40	3.13
28	4.68	4.91	3.58	2.81	2.33	2.65	2.81	4.30	3.31
29	4.62	4.67	3.50	2.80	2.32	2.79	2.81	5.45	3.37
30	4.50	4.53	3.39	2.80	2.31	2.98	2.80	6.60	3.62
31	.....	4.54	.....	2.81	2.33	.....	2.81	.....	3.81

Daily discharge, in second-feet, of Teanaway River near Clealum, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a] 400	718	1,110	187	46	4.0	62	48	1,520
2	371	815	1,430	174	28	3.9	57	190	1,030
3	269	1,420	1,170	165	23	3.2	50	1,620	700
4	298	1,520	920	155	19	3.3	46	920	477
5	395	1,360	853	149	14	3.4	39	920	430
6	245	834	748	149	13	3.3	41	[b] 710	324
7	200	706	664	165	9.2	3.2	41	[b] 500	260
8	390	700	610	152	8.0	3.2	43	290	220
9	790	712	562	140	7.2	3.2	39	307	220
10	742	706	604	126	4.4	3.5	44	298	184
11	598	658	652	149	6.1	3.7	39	264	165
12	640	634	652	118	5.8	3.5	43	231	329
13	913	652	574	138	4.9	3.5	39	217	445
14	1,050	873	493	100	3.9	3.4	36	227	352
15	778	822	522	98	5.1	3.4	33	155	285
16	658	790	516	88	3.7	3.2	32	143	227
17	568	803	456	82	3.5	3.2	32	152	181
18	652	766	430	80	3.9	3.1	32	238	197
19	533	834	415	71	5.3	3.0	32	1,420	200
20	718	760	380	57	5.8	3.4	32	920	132
21	658	706	371	53	6.9	3.7	36	670	90
22	610	676	324	66	5.6	3.9	43	586	71
23	834	664	298	44	5.8	3.7	41	3,270	66
24	873	766	269	38	5.6	4.0	41	3,450	88
25	730	935	249	32	4.9	5.8	41	1,620	116
26	1,110	1,210	252	36	5.3	18	39	900	138
27	980	1,190	238	36	4.2	18	39	670	108
28	840	1,000	249	38	4.0	18	38	610	158
29	803	834	220	36	3.9	35	38	1,470	177
30	730	748	184	36	3.7	71	36	2,930	264
31	.....	754	.....	38	4.0	.....	38	.....	347

[a] Estimated. [b] Interpolated.

NOTE.—These discharges are based on a rating curve that is well defined above a discharge of 36 second-feet.

Monthly discharge of Teanaway River near Clealum, Wash., for 1909.

[Drainage area, 214 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April	1,110	200	646	3.02	3.37	38,400	A.
May	1,520	634	857	4.00	4.61	52,700	A.
June	1,430	184	547	2.56	2.86	32,500	A.
July	187	32	96.6	.451	.52	5,940	A.
August	46	3.5	8.83	.041	.05	543	C.
September	71	3.0	8.29	.039	.04	493	C.
October	62	32	40.1	.187	.22	2,470	B.
November	3,450	48	865	4.04	4.51	51,500	A.
December	1,520	66	306	1.43	1.65	18,800	A.
The period						203,000	

SWAUK CREEK NEAR CLEALUM, WASH.

This station, which is located 1½ miles above the mouth of Swauk Creek, in a narrow canyon on the ranch of B. F. Boice, 12 miles southeast of Clealum, was established April 3, 1909, to determine the amount of water contributed to Yakima River by this drainage area. The canyon of the stream is comparatively narrow and a large part of the water diverted for irrigation is taken out by small ditches and is returned to the stream above the station. One high-line ditch diverts water to lands in the vicinity of Ellensburg, thus taking them out of this drainage area altogether.

The gage is a vertical staff fixed to a stump on the right bank 500 feet below the farmhouse. The banks of the stream are comparatively high and will not overflow except during extreme flood. The bed of the stream is of sand and gravel and liable to change during floods.

Discharge measurements of Swauk Creek near Clealum, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 3	H. D. McGlashan	24	38	2.47	69
June 6	do	27	23	2.08	28
July 27[a]	H. Kimble	15	3.2	1.32	2.1

[a] Made by wading.

Daily gage height, in feet, of Swauk Creek near Clealum, Wash., for 1909.

[B. F. Boice, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.43	2.12	1.58	1.35	1.25	1.22	1.67	3.40
2	.....	2.50	2.22	1.54	1.37	1.24	1.25	2.16	3.20
3	2.48	2.60	2.15	1.54	1.36	1.23	1.36	2.41	2.86
4	2.44	2.61	2.10	1.56	1.34	1.22	1.42	2.18	2.72
5	2.38	2.57	2.06	1.57	1.34	1.22	1.46	1.98	2.75
6	2.35	2.46	2.06	1.58	1.33	1.21	1.52	1.90	2.55
7	2.35	2.38	2.06	1.59	1.32	1.21	1.60	1.85	2.60
8	2.40	2.33	2.00	1.62	1.32	1.20	1.63	1.86	2.50
9	2.50	2.31	1.94	1.62	1.32	1.20	1.66	1.86	2.50
10	2.60	2.32	1.90	1.64	1.32	1.20	1.65	1.84	2.48
11	2.58	2.30	1.90	1.64	1.31	1.20	1.61	1.82	2.38
12	2.64	2.26	1.90	1.56	1.31	1.20	1.60	1.80	2.42
13	2.70	2.26	1.88	1.52	1.32	1.20	1.62	1.74	2.49
14	2.70	2.29	1.88	1.50	1.32	1.20	1.63	1.74	2.42
15	2.62	2.29	1.81	1.50	1.31	1.20	1.63	1.75	2.42
16	2.58	2.27	1.82	1.54	1.30	1.20	1.64	1.75	2.38
17	2.50	2.25	.....	1.52	1.29	1.20	1.65	1.75	2.34
18	2.48	2.22	1.80	1.52	1.29	1.20	1.65	1.82	2.22
19	2.46	2.20	1.78	1.48	1.29	1.20	1.64	2.22	2.18
20	2.47	2.16	1.76	1.42	1.29	1.20	1.60	2.40	2.05
21	2.46	2.16	1.74	1.40	1.28	1.20	1.60	2.20	2.02
22	2.42	.....	1.71	1.40	1.27	1.20	1.60	2.58	2.01
23	2.46	2.10	1.70	1.38	1.28	1.20	1.60	3.30	2.04
24	2.44	2.46	1.70	1.36	1.28	1.20	1.61	3.98	2.12
25	2.53	2.11	1.66	1.35	1.28	1.20	1.61	3.28	2.22
26	2.61	2.12	1.68	1.34	1.28	1.20	1.58	3.00	2.22
27	2.56	2.15	1.64	1.34	1.27	1.20	1.58	2.72	2.20
28	2.53	2.12	1.64	1.34	1.27	1.20	1.58	2.70	2.20
29	2.48	2.13	1.64	1.36	1.26	1.22	1.58	2.84	2.14
30	2.36	2.10	1.60	1.36	1.26	1.22	1.59	3.72	2.08
31	.....	2.10	.....	1.36	1.25	.....	1.58	.....	2.07

NOTE.—The creek was nearly dry during the summer.

Daily discharge, in second-feet, of Swauk Creek near Clealum, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	[a] 80	65	31	6.8	2.5	1.6	1.4	9.2	242
2	[a] 80	75	40	5.9	2.7	1.5	1.6	34	199
3	72	90	34	5.9	2.6	1.5	2.6	62	133
4	67	92	29	6.3	2.4	1.4	3.5	36	109
5	59	86	27	6.5	2.4	1.4	4.2	22	114
6	55	69	27	6.8	2.3	1.4	5.4	18	82
7	55	59	27	7.0	2.1	1.4	7.2	16	90
8	61	53	23	7.8	2.1	1.3	8.0	16	75
9	75	50	20	7.8	2.1	1.3	8.9	16	75
10	90	51	18	8.3	2.1	1.3	8.6	16	72
11	87	49	18	8.3	2.0	1.3	7.5	15	59
12	96	45	18	6.3	2.0	1.3	7.2	14	64
13	106	45	17	5.4	2.1	1.3	7.8	12	74
14	106	48	17	5.0	2.1	1.3	8.0	12	64
15	93	48	14	5.0	2.0	1.3	8.0	12	64
16	87	46	15	5.9	1.9	1.3	8.3	12	59
17	75	44	[b] 14	5.4	1.8	1.3	8.6	12	54
18	72	40	14	5.4	1.8	1.3	8.6	15	40
19	69	38	13	4.6	1.8	1.3	8.3	40	36
20	71	34	12	3.5	1.8	1.3	7.2	61	26
21	69	34	12	3.1	1.8	1.3	7.2	38	24
22	64	[b] 32	10	3.1	1.7	1.3	7.2	87	24
23	69	29	10	2.9	1.8	1.3	7.2	49	25
24	67	69	10	2.6	1.8	1.3	7.5	379	31
25	80	30	8.9	2.5	1.8	1.3	7.5	216	40
26	92	31	9.4	2.4	1.8	1.3	6.8	158	40
27	84	34	8.3	2.4	1.7	1.3	6.8	109	38
28	80	31	8.3	2.4	1.7	1.3	6.8	106	38
29	72	32	8.3	2.6	1.7	1.4	6.8	130	33
30	56	29	7.2	2.6	1.7	1.4	7.0	317	28
31	.....	29	.....	2.6	1.6	.....	6.8	.....	27

[a] Discharge estimated. [b] Discharge interpolated.

NOTE.—These discharges are based on a rating curve that is fairly well defined below a discharge of 75 second-feet, for the period covered by discharge measurements. Above discharge 100 second-feet, the rating curve is only approximated.

Monthly discharge of Swauk Creek near Clealum, Wash., for 1909.

[Drainage area, 90 square miles.]

Month.	Dischage in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April	106	55	76.3	0.848	0.95	4,540	A.
May	92	29	48.6	.540	.62	2,990	A.
June	40	7.2	17.3	.192	.21	1,030	B.
July	8.3	2.4	4.94	.055	.06	304	B.
August	2.7	1.6	1.99	.022	.03	122	C.
September	1.6	1.3	1.34	.015	.02	80	C.
October	8.9	1.4	6.73	.075	.09	414	B.
November	379	9.2	68.0	.756	.84	4,050	B.
December	242	24	67.1	.746	.86	4,130	B.
The period						17,700	

TANEUM CREEK NEAR THORP, WASH.

This station, which is located 6½ miles above Thorp, 150 feet below the logging bridge on the ranch of G. W. De Shazer, was established April 4, 1909, to determine the amount of water contributed by this drainage area to Yakima River, but on account of the many diversions it was necessary to locate the station above them. The highest ditch of importance is Bruton's which heads one-fourth mile below the station.

The gage is a vertical staff fixed to an 8-inch cottonwood tree on the left bank. Measurements are made by wading in the vicinity of the station. The banks of the stream are low, covered with brush, and subject to overflow. The bed of the stream is of sand and gravel and is liable to change at medium and high stages.

Discharge measurements of Taneum Creek near Thorp, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 4 [a]	H. D. McGlashan	24	18	2.50	30
June 7 [a]	do	28	48	3.31	136
July 26 [a]	H. Kimble	18.4	14.2	2.35	14.4
Nov. 30 [b]	do	18	51	3.65	187

[a] Made by wading. [b] Made at a bridge 1 mile below gage.

Daily gage heights, in feet, of Taneum Creek near Thorp, Wash., for 1909.

[L. F. Ellison and W. H. De Shazer, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.85	3.30	2.52	2.30	2.15	2.32	3.05	.....
2	.....	2.95	3.55	2.50	2.29	2.15	2.30	.....	3.20
3	.....	3.05	3.60	2.50	2.29	2.15	2.28	3.20	.....
4	2.50	3.35	3.62	2.47	2.29	2.15	2.25	3.00	.....
5	2.48	3.28	3.50	2.49	2.28	2.15	2.23	2.90	3.05
6	2.48	3.12	3.35	2.60	2.28	2.15	2.30	2.85	3.20
7	2.48	3.08	3.35	2.58	2.28	2.18	2.32	.....	.....
8	2.50	2.95	3.25	2.55	2.27	2.18	2.35	.....	.....
9	2.56	2.95	3.20	2.54	2.27	2.18	2.32	2.80	.....
10	2.65	2.95	3.18	2.54	2.26	2.18	2.32	2.80	.....
11	2.70	2.98	3.15	2.52	2.26	2.18	2.30	2.75	2.84
12	2.72	2.95	3.12	2.53	2.25	2.18	2.30	2.70	2.91
13	2.82	2.90	3.10	2.52	2.25	2.18	2.30	.....	.....
14	2.85	2.95	3.15	2.50	2.22	2.18	2.32	2.68	.....
15	2.80	3.00	3.15	2.48	2.20	2.18	2.32	2.68	.....
16	2.78	3.00	3.20	2.45	2.20	2.18	2.35	2.68	.....
17	2.75	3.00	3.15	2.45	2.20	2.18	2.35	2.68	2.45
18	2.75	3.00	3.05	2.45	2.20	2.21	2.35	2.68	2.40
19	2.72	3.00	2.90	2.45	2.20	2.21	2.35	.....	2.65
20	2.76	2.98	2.90	2.45	2.20	2.22	2.35	3.18	.....
21	2.76	2.92	2.85	2.42	2.18	2.30	2.35	3.00	.....
22	2.78	2.85	2.90	2.40	2.18	2.20	2.35	3.01	.....
23	2.82	2.90	2.80	2.38	2.18	2.48	2.35	3.09	2.60
24	2.85	2.92	2.70	2.38	2.18	2.18	2.35	3.05	.....
25	2.87	3.00	2.70	2.38	2.18	2.18	2.35	3.05	.....
26	3.02	3.15	2.65	2.38	2.18	2.15	2.35	3.03	2.43
27	2.98	3.20	2.62	2.35	2.20	2.15	2.38	3.01	.....
28	2.92	3.25	2.60	2.35	2.20	2.18	2.38	3.10	.....
29	2.85	3.20	2.58	2.30	2.18	2.38	2.38	.....	.....
30	2.82	3.20	2.55	2.30	2.18	2.35	3.35	3.65	2.65
31	.....	3.18	.....	2.30	2.18	.....	2.38	.....	.....

NOTE.—No ice during period covered by records.

Daily discharge, in second-feet, of Taneum Creek near Thorp, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	*a* 30	70	134	31	12	4.0	13	97	154
2	*a* 30	84	172	29	11	4.0	12	108	119
3	*a* 30	97	180	29	11	4.0	10	119	112
4	29	142	183	26	11	4.0	8.8	90	104
5	27	131	164	28	10	4.0	7.8	77	97
6	27	107	142	40	10	4.0	12	70	119
7	27	101	142	38	10	5.3	13	68	109
8	29	84	126	34	10	5.3	16	66	99
9	36	84	119	33	10	5.3	13	64	89
10	46	84	116	33	9.4	5.3	13	64	79
11	52	87	112	31	9.4	5.3	12	58	69
12	54	84	107	32	8.8	5.3	12	52	78
13	67	77	104	31	8.8	5.3	12	51	67
14	70	84	112	29	7.3	5.3	13	50	56
15	64	90	112	27	6.2	5.3	13	50	46
6	62	90	119	24	6.2	5.3	16	50	35
17	58	90	112	24	6.2	5.3	16	50	24
18	58	90	97	24	6.2	6.7	16	50	20
19	54	90	77	24	6.2	6.7	16	83	46
20	59	87	77	24	6.2	7.3	16	116	45
21	59	80	70	21	5.3	12	16	90	44
22	62	70	77	20	5.3	6.2	16	91	43
23	67	77	64	18	5.3	27	16	103	40
24	70	80	52	18	5.3	5.3	16	97	34
25	73	90	52	18	5.3	5.3	16	97	28
26	93	112	46	18	5.3	4.0	16	94	22
27	87	119	42	16	6.2	4.0	18	91	28
28	80	126	40	16	6.2	5.3	18	104	34
29	70	119	38	12	5.3	18	18	146	40
30	67	119	34	12	5.3	16	16	188	46
31	.....	116	.....	12	5.3	.....	18	.....	46

a Discharge estimated.

NOTE.—These discharges are based on a rating curve that is well defined above 16 second-feet. Discharge interpolated for days when gage was not read.

Monthly discharge of Taneum Creek near Thorp, Wash., for 1909.

[Drainage area 76 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April	93	27	54.6	0.718	0.80	3,250	A.
May	142	70	95.5	1.26	1.45	5,870	A.
June	183	34	101.	1.33	1.48	6,010	A.
July	40	12	24.9	.328	.38	1,530	A.
August	12	5.3	7.61	.100	.12	468	B.
September	27	4.0	6.87	.090	.10	409	B.
October	18	7.8	14.3	.188	.22	879	A.
November	188	50	84.5	1.11	1.24	5,030	A.
December	154	20	63.6	.837	.96	3,910	B.
The period						27,400	

MANASTASH CREEK NEAR ELLENSBURG, WASH.

This station, which was established April 5, 1909, to determine the amount of water contributed by the Manastash Creek basin to Yakima River, is located a short distance above the mouth of the canyon, at a private bridge on the ranch of A. L. Sackett and 8½ miles west of Ellensburg, Wash.

Below the canyon the creek spreads in a number of channels and its water is diverted at many points for irrigation. The amount measured at the station, which is at the only suitable point where all the waters are confined in one channel, is considerably reduced by evaporation before the creek reaches Yakima River, into which it finally flows through several channels.

The gage is a vertical staff spiked to a balm tree on the left bank 35 feet below the bridge. Measurements are made from a foot log below the gage or by wading. The banks of the stream are free from vegetation and will overflow in extreme high water. The bed is of gravel and fairly permanent.

Discharge measurements of Manastash Creek near Ellensburg, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 5	H. D. McGlashan	28	25	1.57	41
June 7	do	30	34	2.00	108
July 28	H. Kimble	26	18.5	1.35	19.7
Oct. 8	do	23	13.9	1.20	9.5

Daily gage heights, in feet, of Manastash Creek near Ellensburg, Wash., for 1909.

[A. L. Sackett, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.77	2.22	1.54	1.30	1.17	1.22	1.20	2.02
2	.....	1.81	2.30	1.54	1.29	1.17	1.20	1.40	1.90
3	.....	1.95	2.27	1.52	1.28	1.16	1.20	1.60	1.70
4	.....	2.06	2.20	1.51	1.27	1.16	1.20	1.50	1.70
5	1.58	1.98	2.16	1.50	1.26	1.16	1.20	1.48	1.68
6	1.60	1.92	2.09	1.56	1.42	1.16	1.21	1.40	1.65
7	1.59	1.84	2.05	1.56	1.44	1.16	1.21	1.40	1.58
8	1.67	1.82	2.00	1.52	1.42	1.16	1.20	1.41	1.60
9	1.72	1.84	1.99	1.51	1.40	1.16	1.20	1.40	1.65
10	1.79	1.82	1.97	1.50	1.36	1.16	1.20	1.38	1.65
11	1.81	1.82	1.95	1.50	1.32	1.16	1.20	1.35	1.65
12	1.84	1.80	1.96	1.48	1.30	1.15	1.20	1.34	1.68
13	1.94	1.82	1.92	1.48	1.27	1.15	1.20	1.35	1.55
14	1.90	1.87	1.88	1.46	1.26	1.14	1.19	1.22	1.55
15	1.80	1.92	1.88	1.43	1.24	1.14	1.18	1.20	1.55
16	1.82	1.92	1.90	1.42	1.24	1.13	1.17	1.20	1.55
17	1.82	1.93	1.88	1.41	1.22	1.13	1.16	1.29	1.53
18	1.79	1.90	1.86	1.40	1.22	1.16	1.17	1.35	1.40
19	1.76	1.92	1.82	1.40	1.21	1.17	1.18	1.56	1.40
20	1.78	1.88	1.80	1.40	1.20	1.16	1.18	1.50	1.45
21	1.74	1.85	1.88	1.38	1.19	.....	1.21	1.46	.....
22	1.76	1.86	1.74	1.36	1.20	.....	1.20	1.50	.....
23	1.80	1.90	1.71	1.35	1.18	.....	1.21	2.02	.....
24	1.82	1.89	1.70	1.33	1.18	1.16	1.21	2.45	.....
25	1.84	1.95	1.67	1.32	1.18	1.59	1.21	2.09	.....
26	1.90	2.06	1.65	1.30	1.20	2.00	1.21	1.88	.....
27	1.84	2.14	1.65	1.36	1.20	1.19	1.21	1.78	.....
28	1.80	2.15	1.62	1.36	1.20	1.18	1.20	1.77	.....
29	1.76	2.08	1.60	1.34	1.20	1.28	1.21	1.83	.....
30	1.75	2.02	1.58	1.32	1.19	1.26	1.22	2.20	.....
31	.....	2.02	.....	1.30	1.18	.....	1.22	.....	.....

NOTE.—Stream entirely frozen over from December 21 to 31.

Daily discharge, in second-feet, of Manastash Creek near Ellensburg, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	66	168	37	16	8.8	11	10	113
2	.....	73	194	37	15	8.8	10	24	89
3	.....	98	184	35	15	8.4	10	43	56
4	.....	122	162	34	14	8.4	10	33	56
5	41	104	150	33	14	8.4	10	31	53
6	43	93	130	39	26	8.4	11	24	50
7	42	78	120	39	28	8.4	11	24	41
8	52	75	108	35	26	8.4	10	25	43
9	59	78	106	34	24	8.4	10	24	50
10	70	75	102	33	21	8.4	10	22	50
11	73	75	98	33	18	8.4	10	20	50
12	78	71	100	31	16	8.0	10	19	53
13	97	75	93	31	14	8.0	10	20	38
14	89	84	85	29	14	7.6	9.6	11	38
15	71	93	85	27	12	7.6	9.2	10	38
16	75	93	89	26	12	7.2	8.8	10	38
17	75	95	85	25	11	7.2	8.4	15	36
18	70	89	82	24	11	8.4	8.8	20	24
19	65	93	75	24	11	8.8	9.2	39	24
20	68	85	71	24	10	8.4	9.2	33	28
21	62	80	85	22	9.6	[a] 8.4	11	29	20
22	65	82	62	21	10	[a] 8.4	10	33	20
23	71	89	58	20	9.2	[a] 8.4	11	113	20
24	75	87	56	18	9.2	8.4	11	244	20
25	78	98	52	18	9.2	42	11	130	20
26	89	122	50	16	10	108	11	85	20
27	78	144	50	21	10	9.6	11	68	20
28	71	147	46	21	10	9.2	10	66	20
29	65	127	43	19	10	15	11	76	20
30	64	113	41	18	9.6	14	11	162	20
31	.....	113	.....	16	9.2	.....	11	.....	20

[a] Discharge interpolated.

NOTE.—The discharges, except for frozen period, are based on a rating curve that is well defined between discharges 8 and 227 second-feet. Discharges estimated during frozen period, Dec. 21 to 31.

Monthly discharge of Manastash Creek near Ellensburg, Wash., for 1909.

[Drainage area, 74 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April 5-30	97	41	68.7	1.15	1.12	3,540	A.
May	147	66	94.1	1.27	1.46	5,790	A.
June	194	41	94.3	1.27	1.42	5,610	A.
July	39	16	27.1	.366	.42	1,670	A.
August	28	9.2	14.0	.189	.22	861	A.
September	108	7.2	13.2	.178	.20	786	A.
October	11	8.4	10.2	.138	.16	627	A.
November	244	10	48.8	.659	.74	2,900	A.
December	113	20	38.3	.518	.60	2,360	B.
The period						24,100	

WENAS CREEK NEAR SELAH, WASH.

This station, which was established March 30, 1909, to determine the amount of water contributed by the Wenas Creek basin to Yakima River, is located about one-half mile above the mouth of the creek in the SE. ¼ sec. 18, T. 19 N., R. 14 E.

This station is below all diversions for irrigation and just above a rocky gorge through which the creek flows to its junction with Yakima River.

The gage is a vertical staff on the left bank 200 feet below the ford on Walter Hustead's ranch. Measurements are made by wading or from a foot plank 100 feet above the ford. The banks of the stream are covered with brush and will overflow in extreme high water.

Discharge measurements of Wenas Creek near Selah, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 30	H. D. McGlashan	16	21	2.48	74
Apr. 19	do	12	5.2	1.35	7.6
July 29	H. Kimble	10	3.0	1.25	3.2
Sept. 24	do			1.15	[a] 1.0

[a] Estimated.

Daily gage height, in feet, of Wenas Creek near Selah, Wash., for 1909.

[Walter Hustead, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.48		1.5	1.25	1.3	1.35	1.3	1.3	1.6
2		2.5		1.5	1.25	1.3	1.35	1.3	1.3	1.6
3		2.5		1.5	1.25	1.35	1.4	1.3	1.35	1.6
4		2.4		1.5	1.25	1.3	1.4	1.3	1.35	1.6
5		2.3		1.5	1.25	1.25	1.4	1.35	1.35	1.6
6		2.0		1.5	1.25	1.25	1.4	1.35	1.35	1.7
7		1.7		1.5	1.25	1.25	1.4	1.35	1.35	1.7
8				1.5	1.25	1.2	1.4	1.3	1.35	1.8
9				1.5	1.25	1.2	1.41	1.25	1.35	1.8
10				1.5	1.25	1.2	1.41	1.25	1.35	1.8

Daily gage height, in feet, of Wenas Creek near Selah, Wash., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11				1.5	1.25	1.2	1.4	1.25	1.4	1.8
12				1.5	1.25	1.2	1.45	1.25	1.4	1.8
13				1.5	1.25	1.25	1.4	1.25	1.4	1.8
14				1.5	1.25	1.2	1.4	1.3	1.45	1.9
15				1.5	1.25	1.2	1.4	1.3	1.45	1.9
16				1.4	1.25	1.2	1.4	1.3	1.45	1.9
17				1.4	1.25	1.2	1.4	1.3	1.4	2.0
18				1.4	1.25	1.21	1.4	1.3	1.4	2.0
19		1.35		1.4	1.25	1.2	1.4	1.3	1.5	2.0
20				1.4	1.25	1.2	1.35	1.25	1.5	1.9
21				1.4	1.25	1.2	1.3	1.25	1.5	1.7
22				1.4	1.25	1.25	1.3	1.25	1.5	1.6
23				1.4	1.25	1.25	1.25	1.25	1.6	1.6
24				1.4	1.25	1.3	1.25	1.25	1.6	1.6
25				1.3	1.25	1.35	1.25	1.25	1.6	1.6
26				1.3	1.25	1.35	1.25	1.2	1.6	1.4
27				1.3	1.25	1.4	1.25	1.25	1.6	1.3
28				1.3	1.25	1.4	1.25	1.25	1.6	1.2
29				1.3	1.25	1.4	1.25	1.25	1.6	1.2
30	2.48			1.3	1.25	1.4	1.3	1.25	1.6	1.3
31	2.5				1.25	1.4		1.25	1.6	1.3

NOTE.—The observer misunderstood instructions and read gage to the nearest half foot until Aug. 8. Gage heights from Mar. 30 to July 28 have been adjusted by the district engineer, but are only approximate. After Aug. 8 the records are fair.

Daily discharge, in second-feet, of Wenas Creek near Selah, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	74		15	3.2	5.0	7.5	5.0	5.0	20
2	75		15	3.2	5.0	7.5	5.0	5.0	20
3	75		15	3.2	7.5	10	5.0	7.5	20
4	42		15	3.2	5.0	10	5.0	7.5	20
5	42		15	3.2	3.2	10	7.5	7.5	20
6	42		15	3.2	3.2	10	7.5	7.5	25
7	15		15	3.2	3.2	10	7.5	7.5	25
8	15		15	3.2	2.0	10	5.0	7.5	30
9			15	3.2	2.0	10	3.2	7.5	30
10			15	3.2	2.0	10	3.2	7.5	30
11			15	3.2	2.0	10	3.2	10	30
12			15	3.2	2.0	12	3.2	10	30
13			15	3.2	3.2	10	3.2	10	30
14			15	3.2	2.0	10	5.0	12	36
15			15	3.2	2.0	10	5.0	12	36
16			10	3.2	2.0	10	5.0	12	36
17			10	3.2	2.0	10	5.0	10	42
18			10	3.2	2.2	10	5.0	10	42
19			10	3.2	2.0	10	5.0	15	42
20			10	3.2	2.0	7.5	3.2	15	36
21			10	3.2	2.0	5.0	3.2	15	25
22			10	3.2	3.2	5.0	3.2	15	20
23			10	3.2	3.2	3.2	3.2	20	20
24			10	3.2	5.0	3.2	3.2	20	20
25			5	3.2	7.5	3.2	3.2	20	20
26			5	3.2	7.5	3.2	2.0	20	10
27			5	3.2	10	3.2	3.2	20	5.0
28			5	3.2	10	3.2	3.2	20	2.0
29			5	3.2	10	3.2	3.2	20	2.0
30			5	3.2	10	5.0	3.2	20	5.0
31				3.2	10		3.2		5.0

NOTE.—Discharges estimated as equivalent to 8 second-feet per day Apr. 9 to 30, and as 12 second-feet per day for month of May. Daily discharges for the remainder of the year are based on a curve that is fairly well defined.

Monthly discharge of Wenas Creek near Selah, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April			18.5	1,100	D.
May [a]			12.0	738	D.
June			11.5	684	D.
July			3.20	197	D.
August	10	2.0	4.45	274	C.
September	12	3.2	7.73	460	C.
October	7.5	2.0	4.22	259	C.
November	20	5.0	12.5	744	C.
December	42	2.0	23.7	1,460	C.
The period				5,920	

[a] Estimated.

NOTE.—Discharge April 8 to May 31 estimated. Owing to the unreliability of the gage record, the estimates prior to August are only approximate, but they give a general idea of the discharge of the creek.

NACHES RIVER DRAINAGE BASIN.

DESCRIPTION.

Naches River rises in the western part of Kittitas County, Wash., and flows southeastward into the Yakima above the town of North Yakima. It is about 50 miles long, and receives the drainage from a strip of the eastern slope of the Cascade Range extending from Green Pass southward for about 50 miles. It has a number of tributaries among which are Bumping River, heading in Bumping Lakes, Rattlesnake Creek, Tieton River, and Cowiche Creek. Of these the Tieton is the most important. The headwater streams drain a mountainous country.

NACHES RIVER AT ANDERSON'S RANCH, NEAR NILE, WASH.

This station, which was established April 24, 1909, to obtain data for power and irrigation projects, particularly in connection with the release of stored water from Bumping Lake, is located at Anderson's ranch, 10 miles above Nile post office and 1 mile below the mouth of Gold Creek.

Anderson's ditch diverts water from the left bank about 1 mile above the station but carries a comparatively small amount.

The gage is a vertical staff in two sections, fixed to a yellow pine tree on the left bank directly back of Anderson's house. It is 500 feet downstream from the cable, from which discharge measurements are made.

The right bank is very steep and is covered with alders. The left bank is wooded and will overflow in extreme high water. The bed of the stream is of gravel and cobblestones and is liable to change during freshets.

Discharge measurements of Naches River at Anderson's ranch near Nile, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 24	H. D. McGlashan	128	444	2.53	1,130
June 1	C. F. Gleason	138	669	3.85	3,960
July 5	H. Kimble	131	491	2.88	1,610
Aug. 10	....do	122	306	1.65	344
17	Gleason and Ray	118	280	1.52	288
Sept. 17	H. Kimble	118	251	1.33	189

Daily gage height, in feet, of Naches River at Anderson's ranch near Nile, Wash., for 1909.

[John Anderson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.7	3.5	2.9	1.9	1.4	1.36	1.38	4.0
2	.....	2.85	4.1	2.9	1.85	1.4	1.35	1.9	3.4
3	.....	3.1	4.3	3.0	1.8	1.4	1.33	3.4	3.0
4	.....	3.45	4.1	3.0	1.8	1.4	1.32	2.9	2.8
5	.....	3.4	3.9	2.9	1.8	.....	1.31	2.7	2.6
6	.....	3.1	3.8	2.85	1.75	.....	1.34	2.55	2.5
7	.....	3.0	3.65	2.8	1.7	.....	1.36	2.45	2.5
8	.....	2.9	3.5	2.7	1.7	.....	1.34	2.4	2.3
9	.....	2.9	3.45	2.7	1.65	.....	1.34	2.35	2.3
10	.....	2.9	3.5	2.7	1.63	.....	1.35	2.3	2.2
11	.....	2.85	3.65	2.7	1.6	.....	1.31	2.25	2.15
12	.....	2.75	3.7	2.6	1.6	.....	1.3	2.15	2.3
13	.....	2.8	3.6	2.5	1.65	.....	1.3	2.1	2.3
14	.....	2.9	3.5	2.45	1.55	.....	1.3	2.0	2.3
15	.....	3.0	3.5	2.4	1.5	.....	1.3	1.9	2.15
16	.....	3.0	3.55	2.4	1.5	.....	1.29	1.85	2.05
17	.....	3.0	3.5	2.35	1.5	1.33	1.28	1.85	1.9
18	.....	3.0	3.45	2.3	1.5	1.34	1.28	1.9	1.9
19	.....	3.1	3.4	2.2	1.5	1.33	1.28	2.1	1.9
20	.....	3.0	3.4	2.2	1.5	1.35	1.3	2.35	1.9
21	.....	3.0	3.3	2.19	1.5	1.44	1.34	2.5	1.8
22	.....	2.9	3.2	2.2	1.5	1.4	1.34	2.75	1.8
23	.....	2.9	3.1	2.2	1.5	1.4	1.33	5.0	1.8
24	2.53	3.0	3.05	2.1	1.45	1.35	1.38	6.0	1.9
25	2.57	3.1	3.0	2.1	1.45	1.49	1.38	4.0	1.9
26	2.7	3.3	2.9	2.0	1.45	1.35	1.36	3.0	1.8
27	2.8	3.5	2.9	2.0	1.45	1.33	1.34	2.9	1.8
28	2.8	3.7	2.9	1.95	1.45	1.33	1.34	3.3	1.8
29	2.7	3.5	2.8	2.0	1.45	1.4	1.34	5.5	1.8
30	2.65	3.4	2.8	1.9	1.45	1.4	1.33	5.3	1.9
31	.....	3.4	.....	1.9	1.45	.....	1.39	.....	[a] 2.3

[a] Affected by ice.

NOTE.—Gage not read from Sept. 5 to 16.

Daily discharge, in second-feet, of Naches River at Anderson's ranch, near Nile, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1,340	2,950	1,670	508	221	203	212
2	.....	1,580	4,710	1,670	476	221	198	508
3	.....	2,040	5,350	1,850	444	221	189	2,700
4	.....	2,820	4,710	1,850	444	221	184	1,670
5	.....	2,700	4,100	1,670	444	219	180	1,340
6	.....	2,040	3,800	1,580	404	216	193	1,140
7	.....	1,850	3,360	1,500	385	214	203	1,020
8	.....	1,670	2,950	1,340	385	211	193	960
9	.....	1,670	2,820	1,340	356	209	193	905
10	.....	1,670	2,950	1,340	344	206	198	850

Daily discharge, in second-feet, of Naches River at Anderson's ranch, near Nile, Wash., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	.....	1,580	3,360	1,340	326	204	180	800
12	.....	1,420	3,500	1,200	326	201	175	704
13	.....	1,500	3,220	1,080	356	199	175	658
14	.....	1,670	2,950	1,020	299	196	175	575
15	.....	1,850	2,950	960	272	194	175	508
16	.....	1,850	3,080	960	272	191	171	476
17	.....	1,850	2,950	905	272	189	167	476
18	.....	1,850	2,820	850	272	193	167	508
19	.....	2,040	2,700	750	272	189	167	658
20	.....	1,850	2,700	750	272	198	175	905
21	.....	1,850	2,460	741	272	241	193	1,080
22	.....	1,677	2,240	750	272	221	193	1,420
23	.....	1,670	2,040	750	272	221	189	.....
24	1,120	1,850	1,940	658	246	198	212	.....
25	1,160	2,040	1,850	658	246	267	212	.....
26	1,340	2,460	1,670	575	246	198	203	.....
27	1,500	2,950	1,670	575	246	189	193	.....
28	1,500	3,500	1,670	542	246	189	193	.....
29	1,340	2,950	1,500	575	246	221	193	.....
30	1,270	2,700	1,500	508	246	221	189	.....
31	.....	2,700	.....	508	246	.....	216	.....

NOTE.—These discharges are based on a rating curve that is well defined between 180 and 4,100 second-feet. Discharges interpolated Sept. 5 to 16.

Monthly discharge of Naches River at Anderson's ranch near Nile, Wash., for 1909.

[Drainage area, 391 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April (24-30)	1,500	1,120	1,320	3.38	0.88	18,300	A.
May	3,500	1,340	2,040	5.22	6.02	125,000	A.
June	5,350	1,500	2,880	7.37	8.22	171,000	A.
July	1,850	508	1,050	2.69	3.10	64,600	A.
August	508	246	320	.818	.94	19,700	A.
September	267	189	209	.535	.60	12,400	B.
October	216	167	189	.483	.56	11,600	A.
November (1-22)	2,700	212	912	2.33	1.91	39,800	A.
The period	.....	.....	.....	.....	.....	462,000	

NOTE.—Monthly estimates for the remainder of the year have not been computed, owing to an evident change in the channel during the flood of November and the lack of measurements thereafter.

NACHES RIVER AT OAK FLAT, NEAR NILE, WASH.[1]

This station, which is located 2 miles above the mouth of Tieton River and half a mile above the headgate of the Selah Valley Canal, was established June 25, 1904, to obtain data for use in connection with the development of the excellent power sites above the station, and the equitable distribution of stored water from Bumping Lake reservoir.

The original gage was an inclined staff on the left bank near the cable section. On April 13, 1909, the cable and gage were moved

[1] This station called "Naches River near Nile" in the 1907-8 report.

800 feet upstream to a point affording better gaging conditions. The new gage is of the chain-and-weight type and is fastened to a cantilever beam 75 feet above the cable on the left bank. It was installed at an arbitrary datum; therefore, gage records beginning April 13, 1909, are not comparable with those made at the old station.

Discharge measurements of Naches River at Oak Flat, near Nile, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 19	Stevens and Allen	186	189	3.60	658
Apr. 15	H. D. McGlashan	135	332	5.10	1,480
June 5	Gleason and Ray	138	555	6.98	4,870
21	McGlashan and Harris	138	468	6.23	2,980
July 8	H. Kimble	136	363	5.45	1,780
29	Gleason and Ray	128	193	4.41	645
Aug. 6	H. Kimble	109	178	4.08	445
Sept. 18	do	105	127	3.55	201
Nov. 23	do	148	789	8.40	8,340
Dec. 13	do	135	372	5.54	1,800

NOTE.—Beginning Apr. 15, measurements were made at new location, 800 feet above old station. New gage heights are not comparable with the old.

Daily gage height, in feet, of Naches River at Oak Flat, near Nile, Wash., for 1909.

[W. H. Johnson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.25	3.6	3.3	3.9	5.2	6.4	5.6	4.3	3.7	3.7	3.7	7.6
2	3.25	3.6	3.3	4.0	5.4	7.1	5.7	4.3	3.6	3.7	4.4	6.9
3	3.3	3.5	3.3	4.0	5.8	7.4	5.7	4.3	3.6	3.6	5.8	6.4
4	3.3	3.5	3.3	3.9	6.1	7.2	5.8	4.2	3.6	3.6	5.7	6.0
5	3.3	3.4	3.25	3.9	6.2	7.1	5.8	4.2	3.6	3.6	5.4	5.9
6	3.25	3.4	3.25	3.8	6.0	6.9	5.7	4.1	3.6	3.6	5.3	5.7
7	3.2	3.4	3.25	3.8	5.8	6.7	5.6	4.1	3.6	3.7	5.1	5.5
8	3.1	3.3	3.25	3.9	5.6	6.6	5.5	4.1	3.6	3.7	5.0	5.4
9	3.1	3.3	3.2	4.0	5.6	6.4	5.5	4.0	3.55	3.7	5.0	5.4
10	3.0	3.3	3.2	4.1	5.5	6.5	5.5	4.0	3.55	3.6	4.9	5.3
11	3.0	3.3	3.25	4.1	5.5	6.6	5.5	4.0	3.55	3.6	4.8	5.2
12	3.0	3.25	3.3	4.2	5.4	6.7	5.4	3.9	3.55	3.6	4.7	5.4
13	3.1	3.25	3.4	5.1	5.4	6.7	5.3	3.9	3.55	3.6	4.7	5.5
14	3.1	3.3	3.5	5.2	5.5	6.5	5.3	3.9	3.5	3.5	4.5	5.4
15	3.1	3.3	3.5	5.1	5.6	6.5	5.1	3.9	3.5	3.5	4.3	5.3
16	3.1	3.3	3.6	5.1	5.7	6.6	5.1	3.9	3.5	3.5	4.3	5.2
17	3.45	3.4	3.65	5.1	5.6	6.5	5.0	3.9	3.5	3.5	4.5	5.0
18	3.75	3.5	3.6	5.0	5.6	6.4	4.9	3.8	3.5	3.5	4.9	5.0
19	3.92	3.5	3.6	5.0	5.7	6.4	4.8	3.8	3.5	3.5	6.0	4.9
20	4.1	3.5	3.6	5.1	5.7	6.4	4.8	3.8	3.5	3.5	6.1	4.8
21	4.0	3.5	3.5	5.0	5.6	6.3	4.8	3.8	3.6	3.6	5.7	4.7
22	4.1	3.4	3.5	5.0	5.5	6.2	4.7	3.8	3.7	3.6	6.0	4.6
23	4.1	3.4	3.5	5.1	5.5	6.1	4.7	3.8	3.7	3.6	8.4	4.6
24	3.9	3.4	3.6	5.1	5.5	6.0	4.7	3.7	3.7	3.6	9.0	4.6
25	3.9	3.4	3.7	5.1	5.7	5.9	4.7	3.7	3.7	3.6	7.6	4.5
26	3.8	3.35	3.8	5.3	6.0	5.9	4.6	3.7	3.7	3.6	6.8	4.6
27	3.8	3.35	3.9	5.4	6.2	5.9	4.6	3.7	3.6	3.6	6.4	4.6
28	3.7	3.3	4.0	5.4	6.3	5.8	4.5	3.7	3.6	3.6	6.2	4.5
29	3.7	.....	4.0	5.3	6.2	5.7	4.5	3.7	3.6	3.6	6.6	4.5
30	3.7	.....	4.0	5.2	6.0	5.6	4.4	3.7	3.7	3.6	8.7	4.5
31	3.6	.....	3.9	.....	6.1	.....	4.4	3.7	.....	3.6	.....	4.4

NOTE.—Beginning Apr. 13, 1909, gage heights are referred to the gage at the new location and are not comparable with those referred to the old datum. Ice conditions Jan. 1 to 16 and Feb. 7 to 17.

Daily discharge, in second-feet, of Naches River at Oak Flat, near Nile, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	334	650	404	950	1,470	3,400	2,030	575	270	270	270	6,160
2	334	650	404	1,060	1,740	4,920	2,180	575	230	270	640	4,460
3	364	560	404	1,060	2,340	5,640	2,180	575	230	230	2,340	3,400
4	364	560	404	950	2,840	5,160	2,340	515	230	230	2,180	2,660
5	364	478	371	950	3,020	4,920	2,340	515	230	230	1,740	2,500
6	334	478	371	850	2,660	4,460	2,180	455	230	230	1,600	2,180
7	304	478	371	850	2,340	4,020	2,030	455	230	270	1,340	1,880
8	250	404	371	950	2,030	3,800	1,880	455	230	270	1,210	1,740
9	250	404	338	1,060	2,030	3,400	1,880	405	212	270	1,210	1,740
10	202	404	338	1,170	1,880	3,600	1,880	405	212	230	1,090	1,600
11	202	404	371	1,170	1,880	3,800	1,880	405	212	230	980	1,470
12	202	371	404	1,280	1,740	4,020	1,740	355	212	230	880	1,740
13	250	371	478	1,340	1,740	4,020	1,600	355	212	230	880	1,880
14	250	404	560	1,470	1,880	3,600	1,600	355	195	195	710	1,740
15	250	404	560	1,340	2,030	3,600	1,340	355	195	195	575	1,600
16	250	404	650	1,340	2,180	3,800	1,340	355	195	195	575	1,470
17	519	478	700	1,340	2,030	3,600	1,210	355	195	195	710	1,210
18	800	560	650	1,210	2,030	3,400	1,090	310	195	195	1,090	1,210
19	972	560	650	1,210	2,180	3,400	980	310	195	195	2,660	1,090
20	1,170	560	650	1,340	2,180	3,400	980	310	195	195	2,840	980
21	1,060	560	560	1,210	2,030	3,200	980	310	230	230	2,180	880
22	1,170	478	560	1,210	1,880	3,020	880	310	270	230	2,660	790
23	1,170	478	560	1,340	1,880	2,840	880	310	270	230	8,360	790
24	950	478	650	1,340	1,880	2,660	880	270	270	230	10,100	790
25	950	478	750	1,340	2,180	2,500	880	270	270	230	6,160	710
26	850	441	850	1,600	2,660	2,500	790	270	270	230	4,240	790
27	850	441	950	1,740	3,020	2,500	790	270	230	230	3,400	790
28	750	404	1,060	1,740	3,200	2,340	710	270	230	230	3,020	710
29	750	.....	1,060	1,600	3,020	2,180	710	270	230	230	3,800	710
30	750	.....	1,060	1,470	2,660	2,030	640	270	270	230	9,200	710
31	650	.....	950	.....	2,840	.....	640	270	.....	230	.....	640

NOTE.—These discharges, except during the frozen period Jan. 1 to 16, are based on rating curves applicable as follows: Jan. 1 to Apr. 12, 1909, well defined between 220 and 650 second-feet; Apr. 13 to Dec. 31, 1909, well defined. Discharges estimated for frozen periods, by reducing open water rating 16 per cent.

Monthly discharge of Naches River at Oak Flat, near Nile, Wash., for 1909.

[Drainage area, 636 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	1,170	.....	576	0.906	1.04	35,400	B
February	650	371	476	.748	.78	26,400	B.
March	1,060	338	595	.936	1.08	36,600	A.
April	1,740	850	1,250	1.97	2.20	74,400	A.
May	3,200	1,470	2,240	3.52	4.06	138,000	A.
June	5,640	2,030	3,520	5.53	6.17	209,000	A.
July	2,340	640	1,400	2.20	2.54	86,100	A.
August	575	270	370	.582	.67	22,800	A.
September	270	195	228	.358	.40	13,600	A.
October	270	195	229	.360	.42	14,100	A.
November	10,100	270	2,620	4.12	4.60	156,000	A.
December	6,160	640	1,650	2.59	2.99	101,000	A.
The year	10,100	195	1,260	1.98	26.95	913,000	

NACHES RIVER BELOW TIETON RIVER, NEAR NACHES, WASH.

This station, which is located 5 miles above Naches, Wash., 600 feet below the mouth of Tieton River and 600 feet above the headgate of the Wapatox Power Canal, 500 feet above a waste from the

Selah Valley canal, was established August 4, 1905, and used as a temporary station during the low-water period of 1905. On March 16, 1909, the station was reestablished and equipment installed for making measurements at all stages, in order to obtain data to check the records of the station at Oak Flat on Naches River and at Cobb's ranch on Tieton River. If the diversion in the Selah Valley canal is added to the discharge, at these stations the results should be comparable with the discharges below. During 1909 the water returning to Naches River through this wasteway was not of sufficient amount to affect the results.

The gage is in two sections—an inclined gage on the left bank in the measuring section, which reads to 7.3 feet, and a vertical staff which reads from 7.3 to 16 feet. Measurements are made from a cable.

The right bank of the stream is rather low, is wooded, and is subject to overflow at high stages. The left bank is high, rocky, and will not overflow. The bed of the stream is of gravel and cobblestones, but will change during freshets. Ice is not likely to affect this station except in unusually cold weather.

Discharge measurements of Naches River below Tieton River, near Naches, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	Stevens and Allen	122	425	3.05	1,010
Apr. 21	H. D. McGlashan	140	553	3.88	1,820
June 4	Gleason and Ray	198	956	6.55	7,940
21	McGlashan and Harris	167	754	5.35	4,390
July 6	H. Kimble	153	597	4.50	2,570
29	Gleason and Ray	123	428	3.22	1,080
Sept. 18	H. Kimble	113	291	2.05	338
Dec. 13[a]	do	138	618	4.20	2,590

[a] Section changed, due to flood in December.

Daily gage height, in feet, of Naches River below Tieton River, near Naches, Wash., for 1909.

[W. H. Johnson, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.55	4.3	6.0	4.7	3.2	2.4	2.3	2.3	7.0
2		3.55	4.5	6.7	4.7	3.1	2.4	2.3	3.4	6.3
3		3.55	4.9	6.9	4.7	3.1	2.4	2.2	5.3	5.8
4			5.4	6.7	4.8	3.0	2.4	2.2	5.5	5.4
5			5.5	6.6	4.8	3.0	2.4	2.15	5.3	5.0
6			5.3	6.4	4.8	2.9	2.4	2.15	5.2	4.7
7			5.1	6.3	4.7	2.8	2.4	2.3	4.8	4.5
8			4.9	6.2	4.6	2.8	2.4	2.3	4.3	4.3
9			4.8	6.0	4.6	2.8	2.35	2.3	4.1	4.2
10			4.7	6.1	4.6	2.8	2.35	2.2	3.9	4.0
11			4.6	6.2	4.6	2.7	2.35	2.2	3.7	3.9
12			4.5	6.3	4.5	2.7	2.35	2.2	3.6	4.0
13			4.5	6.3	4.4	2.7	2.3	2.2	3.5	4.1
14			4.6	6.0	4.4	2.7	2.25	2.2	3.3	4.0
15	2.9	4.2	4.7	5.9	4.1	2.6	2.25	2.15	3.1	3.9

Daily gage height, in feet, of Naches River below Tieton River, near Naches, Wash., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.05	4.2	4.8	6.0	4.0	2.6	2.25	2.15	3.0	3.8
17	3.05	4.1	4.8	5.9	3.9	2.6	2.25	2.15	3.4	3.7
18	3.05	4.1	4.8	5.8	3.8	2.6	2.25	2.1	4.0	3.7
19	3.0	4.1	4.9	5.8	3.6	2.6	2.3	2.1	5.1	3.6
20	2.95	4.1	4.9	5.8	3.5	2.5	2.3	2.1	5.3	3.4
21	2.85	4.0	4.8	5.6	3.5	2.5	2.35	2.1	4.9	3.3
22	2.85	4.0	4.7	5.5	3.4	2.5	2.4	2.2	5.3	3.1
23	3.0	4.1	4.7	5.4	3.5	2.4	2.4	2.2	8.2	3.1
24	3.05	4.1	4.7	5.2	3.5	2.4	2.3	2.2	8.9	3.0
25	3.2	4.2	4.9	5.1	3.4	2.4	2.3	2.2	7.1	3.0
26	3.4	4.4	5.3	5.0	3.3	2.4	2.3	2.2	6.5	3.0
27	3.6	4.5	5.5	5.0	3.2	2.6	2.25	2.2	6.0	2.9
28	3.65	4.5	5.8	4.9	3.3	2.5	2.2	2.2	5.8	2.8
29	3.7	4.4	5.8	4.8	3.3	2.5	2.2	2.2	6.2	2.8
30	3.6	4.3	5.6	4.7	3.3	2.4	2.3	2.2	8.0	2.8
31	3.6	.....	5.7	.....	3.2	2.4	.....	2.2	.....	2.7

Daily discharge, in second-feet, of Naches River below Tieton River, near Naches, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,430	2,300	6,200	2,960	1,110	518	460	460	10,200
2	.....	1,430	2,610	8,460	2,960	1,020	518	460	1,290	7,730
3	.....	1,430	3,350	9,180	2,960	1,020	518	410	4,250	6,210
4	.....	1,570	4,510	8,460	3,150	938	518	410	4,770	5,100
5	.....	1,510	4,770	8,100	3,150	938	518	385	4,250	4,150
6	.....	1,440	4,250	7,420	3,150	858	518	385	4,000	3,540
7	.....	1,440	3,770	7,110	2,960	782	518	460	3,150	3,150
8	.....	1,540	3,350	6,800	2,780	782	518	460	2,300	2,800
9	.....	1,710	3,150	6,200	2,780	782	489	460	2,020	2,640
10	.....	1,820	2,960	6,500	2,780	782	489	460	1,790	2,330
11	.....	1,850	2,780	6,800	2,780	710	489	410	1,580	2,180
12	.....	2,090	2,610	7,110	2,610	710	489	410	1,480	2,330
13	.....	2,220	2,610	7,110	2,450	710	460	410	1,380	2,480
14	.....	2,250	2,780	6,200	2,450	710	435	410	1,200	2,330
15	858	2,160	2,960	5,900	2,020	642	435	385	1,020	2,180
16	979	2,160	3,150	6,200	1,900	642	435	385	938	2,030
17	979	2,020	3,150	5,900	1,790	642	435	385	1,290	1,890
18	979	2,020	3,150	5,600	1,680	642	435	360	1,900	1,890
19	938	2,020	3,350	5,600	1,480	642	460	360	3,770	1,760
20	898	2,020	3,350	5,600	1,380	580	460	360	4,250	1,510
21	820	1,900	3,150	5,030	1,380	580	489	360	3,350	1,400
22	820	1,900	2,960	4,770	1,290	580	518	360	4,250	1,190
23	938	2,020	2,960	4,510	1,380	518	518	410	15,000	1,190
24	979	2,020	2,960	4,000	1,380	518	460	410	18,800	1,090
25	1,110	2,160	3,350	3,770	1,290	518	460	410	9,920	1,090
26	1,290	2,450	4,250	3,550	1,200	518	460	410	7,750	1,090
27	1,480	2,610	4,770	3,550	1,110	642	435	410	6,200	1,000
28	1,530	2,610	5,600	3,350	1,200	580	410	410	5,600	920
29	1,580	2,450	5,600	3,150	1,200	580	410	410	6,800	920
30	1,480	2,300	5,030	2,960	1,200	518	460	410	13,900	920
31	1,480	.....	5,300	.....	1,110	518	.....	410	.....	850

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 15 to Nov. 30, 1909, well defined between discharges 320 and 8,100 second-feet; Dec. 1 to Dec. 31, 1909, fairly well defined between discharges 850 and 5,400 second-feet. Discharges, Apr. 4 to 14, estimated by comparison with the Naches River at Oak Flat and Tieton River at head works of Tieton Canal near Naches.

Monthly discharge of Naches River below Ticton River, near Naches, Wash., for 1909.

[Drainage area, 930 square miles.]

Month.	Discharge in second-feet.			Per square mile.	Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.		Depth in inches on drainage area.	Total in acre-feet.	
March 15-31	1,580	820	1,130	1.22	0.77	38,100	A.
April	2,610	1,430	1,950	2.10	2.34	116,000	B.
May	5,600	2,300	3,580	3.85	4.44	220,000	A.
June	9,180	2,960	5,840	6.28	7.01	348,000	A.
July	3,150	1,110	2,060	2.22	2.56	127,000	A.
August	1,110	518	700	.753	.87	43,000	A.
September	518	410	476	.512	.57	28,300	A.
October	460	360	406	.437	.50	25,000	A.
November	18,800	460	4,620	4.97	5.54	275,000	B.
December	10,200	850	2,580	2.77	3.19	159,000	A.
The period						1,380,000	

NACHES RIVER AT NORTH YAKIMA, WASH.

This station was established August 14, 1903, near the mouth of Naches River at North Yakima, Wash., and has been maintained continuously since that date, except during the intervals when gages and gaging equipment were put out of commission by floods.

The data obtained represent the contribution of this drainage area to the flow of the Yakima after all irrigation requirements have been satisfied. The entire flow of the river during the summer months is diverted for irrigation in the Naches and Yakima valleys. The station is located below the lowest diversion for irrigation. The North Yakima power canal, however, diverts 80 to 200 second-feet past the station continuously, a portion of which is wasted into Yakima River.

Gages have been maintained below the Northern Pacific Railway bridge, and on the highway bridge at North Yakima, and on the crib work which extends as a protection for the approach to the railroad bridge on the right bank. The present location of the station was selected June 18, 1908, when a chain gage was installed on the right bank, 800 feet above the railroad bridge. This gage was destroyed October 3, 1909. Gage heights from October 12 to 25, 1909, were used from a temporary staff gage and reduced to the datum of the chain gage. A new chain gage was installed October 26, 1909, at the same place and at the same datum. The datum of these chain gages bears no determined relation to that of the earlier gages.

The location of the measuring section has been changed several times. At first measurements were made at the railroad bridge; then from the highway bridge 200 feet above the railroad bridge, and still later from a cable installed between the two bridges.

The river at the present location of the gage is spanned by a long cable reaching from the high bluff on the left bank to an artificial dike on the right bank. Discharge measurements are now made from this cable.

In the vicinity of North Yakima the river bed is composed of gravel and cobblestone and during heavy floods changes so materially that a new rating is required after each high-water period. At the present location of the gage conditions are such that a good rating curve can be developed for all ordinary and medium stages. During the winter months ice jams frequently occur at the railroad bridge and interfere with the determination of flow to a considerable extent.

Discharge measurements of Naches River at North Yakima, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 25	L. R. Allen	165	397	3.93	1,020
Mar. 5	do	160	299	3.34	468
5	do	160	296	3.34	491
May 19	J. C. Stevens	191	627	5.13	2,780
19	H. D. McGlashan	191	642	5.13	2,880
31	J. C. Stevens	199	726	5.85	4,190
July 20	H. Kimble	171	357	4.05	968
29	do	169	312	3.80	739
Aug. 2	C. F. Gleason	160	265	3.57	535
Sept. 3	do	90	146	2.65	102
22	H. Kimble	105	164	2.92	156
Nov. 20	do	194	632	5.70	3,790
23	do	565	1,880	8.66	17,400
Dec. 5	Gleason and Kimble	205	715	6.35	3,140
9	C. F. Gleason	190	628	5.76	2,110
14	Gleason and Kimble	200	650	5.85	2,250
[a] 22	H. Kimble	185	528	4.97	1,090

[a] Slush ice running. Observed gage height reduced to correct for backwater.

Daily gage height, in feet, of Naches River at North Yakima, Wash., for 1909.

[Mrs. I. J. Oder, observer.]

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.2	3.5	3.35	4.4	4.6	6.2	5.05	3.65	2.71	3.4	3.15	8.6
2	3.3	3.6	3.35	4.3	4.85	7.2	5.0	3.6	2.69	[a] 3.45	3.5	8.0
3	3.4	3.5	3.35	4.25	5.25	7.4	5.0	3.55	2.67	.....	5.7	7.2
4	3.5	3.5	3.3	4.2	5.8	7.2	5.15	3.5	2.65	.....	5.6	6.6
5	3.6	3.5	3.3	4.1	5.9	6.95	5.1	3.45	2.65	.....	4.9	6.35
6	3.55	3.4	3.3	4.05	5.55	6.65	5.0	3.4	2.65	.....	4.75	6.0
7	.....	3.3	3.3	4.05	5.25	6.4	4.9	3.25	2.6	.....	4.5	5.9
8	.....	3.3	3.3	4.18	5.1	6.1	4.9	3.25	2.6	.....	4.4	5.8
9	.....	3.3	3.3	4.25	5.0	6.05	4.85	3.25	2.6	.....	4.4	5.75
10	.....	3.3	3.3	4.3	4.9	6.2	4.8	3.2	2.6	.....	4.35	5.75
11	.....	3.25	3.3	4.3	4.85	6.25	4.7	3.15	2.6	.....	4.15	5.8
12	.....	3.3	3.35	4.4	4.8	6.3	4.65	3.15	2.55	[b] 3.4	4.0	5.9
13	.....	3.3	3.5	4.6	4.9	6.3	4.5	3.05	2.55	3.3	3.95	5.75
14	.....	3.2	3.55	4.6	5.0	6.3	4.45	3.05	2.6	3.15	3.8	5.7
15	.....	3.3	3.7	4.65	5.0	6.25	4.45	3.05	2.6	3.0	3.7	5.7
16	3.8	3.5	3.8	4.65	5.1	6.3	4.45	2.99	2.6	2.95	3.7	5.5
17	4.0	3.7	3.85	4.55	5.15	6.2	4.4	2.97	2.65	2.9	3.8	5.5
18	4.1	3.7	3.9	4.5	5.15	6.1	4.2	2.95	2.65	2.85	4.25	5.2
19	4.3	3.6	3.8	4.5	5.15	6.0	4.05	2.93	2.7	2.9	5.9	5.1
20	4.5	3.6	3.75	4.3	5.15	6.0	4.05	2.91	2.8	2.95	5.7	4.85

[a] Chain gage destroyed.
[b] Temporary gage put in. Gage heights Oct. 12-25 reduced to chain gage datum.

Daily gage height, in feet, of Naches River at North Yakima, Wash., for 1909—Continued.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	4.7	3.5	3.75	4.3	5.1	5.9	4.0	2.89	2.8	2.9	5.2	5.1
22	4.6	3.5	3.7	4.35	5.1	5.7	4.0	2.87	2.85	2.9	5.2	5.2
23	4.2	3.4	3.7	4.25	5.1	5.6	4.0	2.85	2.85	2.9	8.66	5.2
24	4.0	3.45	3.75	4.3	5.15	5.45	3.95	2.83	2.9	2.9	[a] 9.0	5.2
25	3.9	3.4	3.8	4.6	5.3	5.3	3.95	2.82	2.9	2.9	8.8	5.2
26	3.75	3.4	4.05	4.8	5.7	5.3	3.95	2.81	2.95	[b] 2.95	8.6	5.2
27	3.8	3.35	4.25	4.7	6.0	5.3	3.85	2.80	3.0	2.95	7.9	5.2
28	3.95	3.35	4.25	4.65	6.05	5.35	3.85	2.79	3.2	3.0	7.2	5.2
29	4.0	.....	4.3	4.65	6.05	5.2	3.8	2.77	3.45	3.0	7.4	5.2
30	4.0	.....	4.35	4.55	6.05	5.05	3.8	2.75	3.5	3.05	9.2	5.15
31	3.7	.....	4.35	.....	6.1	.....	3.7	2.73	.....	3.1	.....	5.0

[a] New chain gage installed at original datum.
[b] Maximum stage 9.8 at 10 a. m.

NOTE.—Ice conditions: During January and the first part of February the river was partially frozen over to a depth varying from 2 to 7 inches, but for the greater portion of this period it was open at the gage. From Dec. 21 to 31 the gage heights were affected by backwater, caused by slush ice.

Daily discharge, in second-feet, of Naches River near North Yakima, Wash., for 1909.

Days.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	348	544	490	1,610	1,910	5,160	2,530	605	115	410	255	10,800
2	410	621	490	1,470	2,310	8,770	2,440	565	112	448	485	8,100
3	480	544	490	1,400	3,020	9,760	2,440	525	108	444	3,800	5,280
4	560	605	455	1,340	4,150	8,770	2,710	485	106	440	3,590	3,660
5	552	605	455	1,220	4,380	7,640	2,620	448	106	436	2,270	3,140
6	514	525	455	1,160	3,620	6,450	2,440	410	106	433	2,020	2,500
7	536	455	455	1,160	3,020	5,550	2,270	310	98	429	1,620	2,340
8	558	455	455	1,320	2,740	4,680	2,270	310	98	425	1,460	2,180
9	580	455	455	1,400	2,560	4,560	2,180	310	98	421	1,460	2,100
10	602	455	455	1,470	2,390	4,940	2,100	280	98	418	1,380	2,100
11	624	422	455	1,470	2,310	5,080	1,940	255	98	414	1,100	2,180
12	645	455	490	1,610	2,230	5,230	1,860	255	93	410	925	2,340
13	667	455	605	1,910	2,390	5,230	1,620	210	93	340	875	2,100
14	688	390	648	1,910	2,560	5,230	1,540	210	98	255	735	2,020
15	710	455	780	1,990	2,560	5,080	1,540	210	98	190	645	2,020
16	731	605	880	1,990	2,740	5,230	1,540	186	98	172	645	1,730
17	918	780	935	1,840	2,840	4,940	1,460	180	106	155	735	1,730
18	1,200	780	990	1,760	2,840	4,680	1,170	172	106	142	1,240	1,350
19	1,470	690	880	1,760	2,840	4,440	982	166	113	155	4,220	1,240
20	1,760	690	830	1,470	2,840	4,440	982	158	130	172	3,800	1,020
21	2,070	605	830	1,470	2,740	4,220	925	152	130	155	2,800	1,140
22	1,910	605	780	1,540	2,740	3,800	925	148	142	155	2,800	1,240
23	1,340	525	780	1,400	2,740	3,590	925	142	142	155	17,100	1,240
24	1,100	565	830	1,470	2,840	3,280	875	138	155	155	19,500	1,240
25	990	525	880	1,910	3,120	2,990	875	135	155	155	17,000	1,240
26	830	525	1,160	2,230	3,930	2,990	875	132	172	172	14,700	1,240
27	880	490	1,400	2,070	4,620	2,990	780	130	190	172	9,700	1,240
28	940	490	1,400	1,990	4,750	3,080	780	128	280	190	6,000	1,240
29	990	.....	1,470	1,990	4,750	2,800	735	125	448	190	6,000	1,240
30	990	.....	1,540	1,840	4,750	2,530	735	122	485	210	14,300	1,190
31	702	.....	1,540	.....	4,880	.....	645	118	.....	230	.....	1,060

NOTE.—These discharges are based on rating curves applicable as follows:
June 19, 1908, to Jan. 21, 1909, well defined above 210 second-feet.
Jan. 22 to June 3, 1909, fairly well defined.
June 4, to Nov. 23, 1909, fairly well defined.
Nov. 24 to Nov. 29, 1909, the indirect method for shifting channels used.
Nov. 30 to Dec. 31, 1909, fairly well defined.
Discharge for frozen period Jan. 5 to 17 reduced 15 per cent and that for Jan. 28 to Feb. 3 reduced 10 per cent to allow for ice conditions. Discharge estimated Dec. 21 to 31 because of backwater.
Discharge interpolated Oct. 3 to 11.

Monthly discharge of Naches River at North Yakima, Wash., for 1909.

[Drainage area, 1,120 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	2,070	348	880	0.786	0.91	54,100	C.
February	780	390	547	.488	.51	30,400	B.
March	1,540	455	799	.713	.82	49,100	A.
April	2,230	1,160	1,640	1.46	1.63	97,600	A.
May	4,880	1,910	3,160	2.82	3.25	194,000	A.
June	9,760	2,530	4,940	4.41	4.92	294,000	A.
July	2,710	645	1,540	1.38	1.59	94,700	A.
August	605	118	249	.222	.26	15,300	A.
September	485	93	146	.130	.15	8,690	A.
October	448	142	279	.249	.29	17,200	B.
November	19,500	255	4,790	4.28	4.78	285,000	B.
December	10,800	1,020	2,360	2.11	2.43	145,000	C
The year	19,500	93	1,780	1.59	21.54	1,290,000	

BUMPING RIVER DRAINAGE BASIN.

DESCRIPTION.

Bumping River rises in Fish Lake, near Carlton Pass, at an altitude of about 4,300 feet above sea level, and flows northeastward about 10 miles to Bumping Lake, which lies about 3,400 feet above sea level. Thence it flows northeasterly about 15 miles to its junction with Naches River. About 4 miles above its mouth it receives its principal tributary, American River, a stream which heads on the high divide of the Cascade Range and flows northeastward. The area drained by American River is heavily forested, and its flow is supplied largely by snow banks.

Bumping Lake, which is located in the Mount Rainier Forest Reserve about 12 miles in a direct line nearly due east from Mount Rainier, 46 miles northwest of Naches, and 20 miles southwest of Nile, is to be used as a storage reservoir, from which water will be released to replace in the lower Naches River water diverted from Tieton River for the Tieton project.

BUMPING LAKE NEAR NILE, WASH.

A vertical staff gage was installed on the north shore of Bumping Lake about one-fourth mile above the outlet April 27, 1909, to obtain data for use in connection with the operation of the storage reservoir. When surveys of the lake have been completed it will be possible to develop a storage table similar to that for the lakes at the headwaters of Yakima River, to be used in connection with the station on Bumping River to determine the natural flow of the river.

Daily gage height, in feet, of Bumping Lake near Nile, Wash., for 1909.

[F. H. Thompson, observer.]

Days.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	4.5	6.5	5.4	3.89	3.39	.....	.....
2	.....	4.55	7.0	5.4	3.88	3.39	.....	4.0
3	.....	4.6	7.1	5.42	3.87	3.38	3.53	9.55
4	.....	4.75	7.0	5.3	3.8	3.38	.....	9.7
5	.....	4.75	6.8	5.2	3.78	3.37	.....	9.68
6	.....	4.75	6.5	5.2	3.74	3.4	3.56	9.45
7	.....	4.75	6.1	5.1	3.73	3.41	.....	9.28
8	.....	4.75	6.2	5.0	3.72	3.4	.....	9.02
9	.....	4.7	6.15	5.0	3.7	3.41	.....	8.53
10	.....	4.7	6.0	5.0	3.68	3.39	.....	8.02
11	.....	4.68	6.2	5.0	3.64	3.44	.....	7.27
12	.....	4.68	6.5	4.9	3.62	3.44	.....	.....
13	.....	4.68	6.2	4.8	3.6	3.5	3.48	.....
14	.....	4.68	6.2	4.7	3.58	3.5	.....	.....
15	.....	4.7	6.1	4.7	3.55	3.5	.....	8.02
16	.....	4.7	6.2	4.61	3.53	3.52	3.5	.....
17	.....	4.75	6.2	4.52	3.53	.....	4.7	5.47
18	.....	4.8	6.2	4.44	3.51	.....	3.59	.....
19	.....	4.85	6.1	4.4	3.52	.....	3.65	.....
20	.....	5.2	6.1	4.3	3.49	.....	3.9	.....
21	.....	5.2	6.1	4.3	3.49	.....	3.9	.....
22	.....	5.2	5.4	4.3	3.48	3.73	3.94	12.2
23	.....	5.2	5.4	4.28	3.47	.....	3.97	.....
24	.....	5.15	5.3	4.2	3.44	.....	4.0	.....
25	.....	5.3	5.3	4.15	3.44	.....	4.02	.....
26	.....	5.6	5.3	4.1	3.48	.....	4.0	.....
27	4.5	5.7	5.4	4.09	3.45	.....	3.98	.....
28	4.5	5.7	5.1	4.03	3.42	.....	.....	.....
29	4.5	5.7	5.1	4.0	3.42	3.78	.....	.....
30	4.5	5.8	5.1	3.9	3.41	.....	.....	.....
31	.....	6.0	.....	3.9	3.4	.....	.....	.....

BUMPING RIVER AT BUMPING LAKE, NEAR NILE, WASH.

This station was first established June 13, 1906, at a point about 600 feet below the outlet of Bumping Lake, but records were not kept continuously, except for a short period in 1906, until it was reestablished, on July 3, 1909. Its present location is 1,200 feet below the site of the Bumping Lake storage dam, 100 feet below the end of the spillway. The data obtained here will be valuable in connection with the release of stored water from Bumping Lake.

Two gages were installed, one on the bridge at the dam site and the other at the cable section 1,200 feet below. Observations were begun at the bridge gage April 27 and discontinued September 16. Observations were begun at the cable gage August 7. Simultaneous observations have been obtained and all gage heights are referred to the cable gage.

The right bank of the stream is heavily wooded and overflows at a gage height of 5 feet. The left bank is nearly vertical to a point above high water and is heavily timbered. The bed of the stream is of coarse gravel and cobblestones and is fairly permanent. There is a riffle control 200 feet below the station.

Discharge measurements of Bumping River at Bumping Lake, near Nile, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft*	*Feet.*	*Sec.-ft.*
Apr. 27	H. D. McGlashan	109	200	2.83	289
July 3	Howard Kimble	104	284	3.81	726
Aug. 9	.....do	94	112	2.10	123
Sept. 16[a]	.....do	51	88	1.68	57

[a] Made from cable.

Daily gage height, in feet, of Bumping River at Bumping Lake, near Nile, Wash., for 1909.

[F. H. Thompson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.94	4.65	3.82	2.37	1.76	1.8	1.85	4.85
2		3.07	5.36	3.75	2.3	1.76	1.76	2.64	4.6
3		3.15	5.46	3.82	2.3	1.75	1.74	3.45	3.85
4		3.4	5.36	3.7	2.27	1.74	1.7	3.55	3.6
5		3.4	4.74	3.6	2.23	1.73	1.73	3.5	3.4
6		3.4	4.74	3.54	2.18	1.71	1.76	3.45	3.2
7		3.42	4.54	3.54	2.16	1.73	1.74	3.4	3.05
8		3.4	4.34	3.54	2.13	1.71	1.72	3.35	3.0
9		3.38	4.24	3.54	2.09	1.69	1.71	3.28	2.95
10		3.38	4.34	3.4	2.07	1.68	1.7	3.2	2.9
11		3.3	4.34	3.34	2.04	1.67	1.69	3.1	2.85
12		3.3	4.65	3.28	2.02	1.66	1.69	3.0	3.2
13		3.3	4.34	3.22	2.0	1.65	1.69	2.9	3.1
14		3.3	4.34	3.18	2.0	1.65	1.65	2.8	3.2
15		3.38	4.34	3.12	1.96	1.63	1.62	2.7	3.1
16		3.38	4.44	3.1	1.93	1.63	1.61	2.61	3.0
17		3.4	4.44	3.0	1.93	1.63	1.6	2.53	2.9
18		3.5	4.54	3.0	1.91	1.63	1.59	2.9	2.8
19		3.54	4.34	2.78	1.93	1.69	1.62	3.4	2.7
20		3.54	4.24	2.78	1.89	1.75	1.67	3.5	2.65
21		3.54	4.24	2.78	1.87	1.88	1.7	3.5	2.6
22		3.54	4.12	2.78	1.85	1.84	1.71	3.58	2.6
23		3.54	4.12	2.75	1.84	1.82	1.74	6.6	2.6
24		3.54	4.12	2.74	1.82	1.79	1.77	6.1	2.6
25		3.6	3.6	2.65	1.82	1.84	1.79	5.0	2.55
26		3.92	3.54	2.6	1.83	1.78	1.78	4.35	2.5
27	2.88	3.97	3.6	2.55	1.82	1.72	1.76	3.9	2.5
28	2.88	4.02	3.6	2.54	1.8	1.74	1.76	.....	2.45
29	2.88	4.02	3.6	2.54	1.8	1.76	1.76	.....	2.4
30	2.94	4.12	3.6	2.42	1.79	1.78	1.79	.....	2.5
31		4.34	.....	2.4	1.77	.....	1.82	.....	2.5

NOTE.—Dec. 20 to 31, river frozen along edges. The flow is undoubtedly affected by ice conditions in January and February. Gage heights, Apr. 26 to Aug. 6 determined from relation curve between bridge and cable gages.

Daily discharge, in second-feet, of Bumping River at Bumping Lake, near Nile, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		332	1,300	729	171	67	72	78	1,460
2		377	1,890	689	156	67	67	239	1,260
3		407	1,980	729	156	66	65	534	746
4		511	1,890	661	150	65	60	583	634
5		511	1,370	608	142	64	64	558	511
6		511	1,370	578	132	61	67	534	426
7		520	1,220	578	128	64	65	511	370
8		511	1,070	578	123	61	62	489	352
9		502	998	578	115	59	61	459	335
10		502	1,070	511	112	58	60	426	318

Daily discharge, in second-feet, of Bumping River at Bumping Lake, near Nile, Wash., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	467	1,070	485	107	57	59	388	302
12	.....	467	1,300	459	103	56	59	352	426
13	.....	467	1,070	434	100	55	59	318	388
14	.....	467	1,070	418	100	55	55	286	426
15	.....	502	1,070	396	94	53	52	256	388
16	.....	502	1,140	388	90	53	51	231	352
17	.....	511	1,140	352	90	53	50	210	318
18	.....	558	1,220	352	86	53	49	318	286
19	.....	578	1,070	280	90	59	52	511	256
20	.....	578	998	280	84	66	57	558	242
21	.....	578	998	280	81	82	60	558	228
22	.....	578	916	280	78	77	61	598	228
23	.....	578	916	271	77	75	65	3,100	228
24	.....	578	916	268	75	71	68	2,600	228
25	.....	608	608	242	75	77	71	1,580	215
26	.....	788	578	228	76	70	70	1,080	202
27	312	819	608	215	75	62	67	776	202
28	312	851	608	212	72	65	67	720	190
29	312	851	608	212	72	67	67	720	178
30	332	916	608	183	71	70	71	2,000	202
31	.....	1,070	.....	178	68	.....	75	.....	202

NOTE.—These discharges are based on a rating curve that is well defined between 60 and 840 second-feet. Discharge estimated, Nov. 28 to 30.

Monthly discharge of Bumping River at Bumping Lake, near Nile, Wash., for 1909.

[Drainage area, 68 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
May	1,070	332	581	8.54	9.85	35,700	A.
June	1,980	578	1,090	16.00	17.85	64,900	A.
July	729	178	408	6.00	6.92	25,100	A.
August	171	68	102	1.50	1.73	6,270	A.
September	82	53	63.6	.935	1.04	3,780	B.
October	75	49	62.2	.915	1.05	3,820	B.
November	3,100	78	719	10.6	11.83	42,800	B.
December	1,460	178	390	5.74	6.62	24,000	B.
The period	.....	.....	.....	.....	.....	206,000	

AMERICAN RIVER NEAR NILE, WASH.

The station, which is located at a highway bridge three-fourths of a mile above the mouth of American River, 35 miles above Naches and 20½ miles above Nile, was established April 25, 1909, for use in connection with the releasing of water stored in Bumping Lake Reservoir.

The gage is a vertical staff fixed to the right abutment of the bridge from which measurements are made. On account of the isolation of the station it is practically impossible to obtain continuous observations.

The right bank is high and wooded and will not overflow. The left bank is low and will overflow in extreme flood. The bed of the stream is composed of gravel and cobblestones and is fairly permanent.

Discharge measurements of American River near Nile, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28	H. D. McGlashan	57	105	2.65	358
July 4	Howard Kimble	57	155	3.35	735
Aug. 10	do	55	72	2.05	116
Sept. 17	do	50	53	1.65	52

Daily gage height, in feet, of American River near Nile, Wash., for 1909.

[H. J. Undi and A. J. Ryckman, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	2.73	4.05	3.28	2.35	1.75	1.65	16	.....	3.05	3.82	2.95	1.95	1.65	1.6
2	.....	2.86	4.55	3.37	2.3	1.75	1.65	17	.....	2.96	3.68	2.85	1.95	1.65	1.6
3	.....	3.15	4.46	3.42	2.3	1.75	1.65	18	.....	3.0	3.78	2.8	1.9	1.65	1.6
4	.....	3.5	4.14	3.42	2.25	1.75	1.65	19	.....	3.05	3.68	2.7	1.9	1.65	1.6
5	.....	3.46	3.96	3.28	2.25	1.7	1.65	20	.....	3.0	3.6	2.75	1.9	1.65	1.65
6	.....	3.19	3.86	3.28	2.2	1.7	1.65	21	.....	2.86	3.6	2.65	1.9	1.7	1.65
7	.....	3.05	3.73	3.19	2.15	1.7	1.65	22	.....	2.96	3.6	2.85	1.85	1.7	1.7
8	.....	2.96	3.64	3.0	2.1	1.7	1.65	23	.....	2.91	3.5	2.85	1.85	1.7	1.7
9	.....	3.0	3.64	3.19	2.1	1.7	1.65	24	.....	3.05	3.32	2.85	1.85	1.65	1.75
10	.....	2.96	3.73	3.19	2.05	1.7	1.65	25	2.82	3.28	3.24	2.65	1.85	1.65	1.75
11	.....	2.91	3.96	3.25	2.05	1.7	1.65	26	2.86	3.46	3.28	2.55	1.85	1.65	1.75
12	.....	2.86	4.1	3.05	2.00	1.7	1.65	27	2.73	3.6	3.55	2.5	1.85	1.65	1.7
13	.....	2.86	3.82	2.9	2.0	1.65	1.65	28	2.64	3.68	3.24	2.45	1.85	1.65	1.7
14	.....	3.0	3.68	2.95	2.0	1.65	1.65	29	2.68	3.6	3.00	2.4	1.8	1.7	1.65
15	.....	3.0	3.82	2.95	1.95	1.65	1.65	30	2.64	3.5	3.24	2.4	1.8	1.65	1.65
								31	.....	3.55	.....	2.4	1.8	.....	.....

NOTE.—Gage readings were suspended Nov. 1 for lack of an observer.

Daily discharge, in second-feet, of American River near Nile, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	377	1,220	688	215	66	52	16	.....	549	1,050	492	102	52	45
2	.....	444	1,580	745	197	66	52	17	.....	498	956	438	102	52	45
3	.....	608	1,510	777	197	66	52	18	.....	520	1,030	412	92	52	45
4	.....	830	1,280	777	181	66	52	19	.....	549	956	362	92	52	45
5	.....	804	1,150	688	181	58	52	20	.....	520	900	387	92	52	52
6	.....	632	1,080	688	165	58	52	21	.....	444	900	339	92	58	52
7	.....	549	991	632	150	58	52	22	.....	498	900	438	83	58	58
8	.....	498	928	520	136	58	52	23	.....	470	830	438	83	58	58
9	.....	520	928	632	136	58	52	24	.....	549	713	438	83	52	66
10	.....	498	991	632	124	58	52	25	423	688	663	339	83	52	66
11	.....	470	1,150	669	124	58	52	26	444	804	688	294	83	52	66
12	.....	444	1,250	549	112	58	52	27	377	900	865	273	83	52	58
13	.....	444	1,050	465	112	52	52	28	334	956	663	253	83	52	58
14	.....	520	956	492	112	52	52	29	353	900	520	233	74	58	52
15	.....	520	1,050	492	102	52	52	30	334	830	663	233	74	52	52
								31	.....	865	.....	233	74	.....	52

NOTE.—These discharges are based on a rating curve that is well defined between 45 and 760 second-feet.

Monthly discharge of American River near Nile, Wash., for 1909.

[Drainage area, 78 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Apr. 25-30	444	334	378	4.85	1.08	4,500	A.
May	956	377	603	7.73	8.91	37,100	A.
June	1,580	520	980	12.6	14.06	58,300	A.
July	777	233	485	6.22	7.17	29,800	A.
August	215	74	117	1.50	1.73	7,190	A.
September	66	52	56.3	.722	.81	3,350	B.
October	66	45	53.2	.682	.79	3,270	B.
The period						144,000	

TIETON RIVER DRAINAGE BASIN.

DESCRIPTION.

Tieton River, the principal tributary of the Naches, rises on the eastern slopes of the Cascade Range in the vicinity of Cowlitz Pass and flows in a general northeasterly direction, joining Naches River about 17 miles above the junction of the latter with the Yakima. A peculiarity of the river is the turbid milk-white appearance of its waters. The water of the South Fork of the Tieton, 25 miles above its mouth, is, however, perfectly clear. The forks head in the glaciers of a peak of the Cascades known locally as Goat Rock.

About 4 miles below the fork is a remarkable soda spring whose waters are very palatable.

The entire flow of Tieton River at low stages will be diverted to irrigate lands in the vicinity of North Yakima. The amount so taken will be replaced from the Bumping Lake storage reservoir on the headwaters of the Naches.

TIETON RIVER AT M'ALLISTER MEADOWS, NEAR NACHES, WASH.

This station, which is located 800 feet above the McAllister Meadows dam site and about 30 miles southwest of Naches, Wash., was established August 28, 1908, to determine the relation between the flow at this point and that at the headworks of the Tieton Canal and at the mouth of Tieton River, where records of several years standing are available.

The station is about 1½ miles below the mouth of South Fork of Tieton River, half a mile above the mouth of Wildcat Creek, and 9 miles above the headworks of Tieton Canal.

The vertical staff gage is nailed to a tree on the left bank, 100 feet above the cable, from which discharge measurements are made.

Discharge measurements of Tieton River at McAllister Meadows near Naches, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Dis-charge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 7	H. Kimble	102	222	2.60	713
Aug. 10	Richie Ray	99	160	2.00	380
Sept. 21	H. Kimble	94	120	[a] 1.60	233

[a] Gage height of zero flow is 0.0.

Daily gage height, in feet, of Tieton River at McAllister Meadows near Naches, Wash., for 1909.

[John Russell, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.9	2.1	3.7	2.70	2.02	1.60	1.40	1.4	4.0
2		1.8		4.0	2.80		1.70	1.40	3.8	3.5
3		1.8	2.6	3.9	2.80	1.95	1.80	1.37	4.1	3.2
4		1.8		3.6	2.75	2.00	1.72	1.37	3.1	2.9
5			2.7	3.4	2.70			1.37	2.7	
6		1.8	2.6	3.3	2.74	1.95	1.65	1.79	2.3	2.7
7		1.8		3.2	2.60		1.60	1.55		
8		1.8	2.5	3.1	2.55	1.80	1.70	1.42		2.4
9					2.62		1.55	1.68		2.3
10		1.9	2.4	3.1	2.65	1.81	1.72	1.62		2.4
11		2.0		3.2	2.65	1.84	1.59	1.55		2.6
12			2.2	3.4	2.60	1.84	1.48	1.65		3.0
13		2.1	2.3	3.2	2.20		1.60	1.50		2.7
14		2.1		3.1	2.25	1.82	1.50	1.42	1.7	2.6
15		2.0	2.4	3.5	2.40	1.76	1.60	1.41	1.6	2.45
16				3.4	2.35			1.45	1.55	2.3
17		2.0	2.3	3.38	2.25	1.70	1.50		1.6	2.2
18		2.0		3.30	2.15	1.82	1.35	1.45	3.3	2.1
19			2.4	3.28	2.10		1.45	1.38		2.1
20		2.0	2.6	3.20	2.08	1.82		1.35	3.3	2.1
21	1.5	2.1		3.10		1.81	1.58	1.40	3.7	
22			2.3	3.10	2.10			1.35	3.9	2.1
23	1.6	2.1	2.5	2.94		1.60	1.45	1.32	6.2	2.1
24	1.6		2.6	2.85	2.14			1.35	5.8	2.05
25		2.1		2.85	2.15	1.50	1.60		4.4	
26	1.6		3.0	2.90	2.10	2.05	1.50	1.31	3.7	2.0
27		2.4	3.2	2.87	2.15	1.80	1.45		3.3	1.95
28	1.9	2.3	3.1	2.70	2.05	1.70	1.55	1.30	3.7	1.85
29	1.8	2.1	3.0	2.65	2.05	1.50	1.65	1.30	4.8	1.8
30	1.9		2.8	2.68	2.10	1.46		1.25		1.7
31	1.9		3.1		2.05	1.70				1.6

NOTE.—Ice did not interfere during period covered by gage records.

Daily discharge, in second-feet, of Tieton River at McAllister Meadows, near Naches, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		418	515	1,660	785	389	238	180	180	1,820
2		375	660	1,930	860	374	271	180	1,650	1,400
3		375	805	1,740	860	360	305	173	1,910	1,160
4		375	838	1,480	822	380	278	173	1,080	935
5		375	870	1,320	785	370	266	173	785	910
6		375	805	1,240	815	360	254	302	430	785
7		375	772	1,160	715	332	238	223	475	638
8		375	740	1,080	682	305	271	186	425	490
9		396	710	1,080	729	306	223	264	380	430
10		418	680	1,080	750	308	278	245	340	490

Daily discharge, in second-feet, of Tieton River at McAllister Meadows, near Naches, Wash., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	465	625	1,190	750	319	235	223	305	715
12	.....	490	570	1,320	715	319	202	254	288	1,010
13	.....	515	625	1,160	475	316	238	208	271	785
14	.....	515	652	1,080	502	312	208	186	271	715
15	.....	465	680	1,400	490	291	238	183	238	520
16	.....	465	652	1,320	460	281	223	194	223	430
17	.....	465	625	1,300	502	271	208	194	238	475
18	.....	465	625	1,240	450	312	168	194	1,240	425
19	.....	465	680	1,220	425	312	194	175	1,240	425
20	.....	465	805	1,160	416	312	213	168	1,240	425
21	267	515	715	1,080	420	308	232	180	1,560	425
22	283	515	625	1,080	425	273	213	168	1,740	425
23	299	515	740	965	435	238	194	161	4,200	425
24	299	515	805	898	445	223	216	168	3,720	402
25	299	515	942	898	450	208	238	163	2,210	391
26	299	598	1,080	935	425	402	208	158	1,560	380
27	358	680	1,240	912	450	305	144	157	1,240	360
28	418	625	1,160	785	402	271	223	156	1,560	322
29	375	515	1,080	750	402	208	254	156	2,610	305
30	418	515	940	771	425	197	217	146	2,220	271
31	418	.....	1,160	.....	402	271	.....	163	.....	238

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 21 to June 2, 1909, fairly well defined between 270 and 400 second-feet; June 3 to Dec. 31, 1909, fairly well defined between 270 and 800 second-feet.

Monthly discharge of Tieton River at McAllister Meadows, near Naches, Wash., for 1909.

[Drainage area, 187 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Mar. 21–31	418	267	339	1.81	0.74	7,400	B.
April	680	375	471	2.52	2.81	28,000	B.
May	1,240	515	788	4.21	4.85	48,500	B.
June	1,930	750	1,170	6.26	6.98	69,600	B.
July	860	402	570	3.05	3.52	35,000	A.
August	402	197	304	1.63	1.88	18,700	A.
September	305	168	231	1.24	1.38	13,700	A.
October	302	146	189	1.01	1.16	11,600	B.
November	4,200	223	1,190	6.36	7.10	70,800	B.
December	1,820	238	611	3.27	3.77	37,500	A.
The period	.....	.....	.....	.....	.....	341,000	

TIETON RIVER AT HEADWORKS OF TIETON CANAL, NEAR NACHES, WASH.

This station was first established March 29, 1906, about 1 mile below the intake of Tieton Canal, about 21 miles southwest of Naches, Wash. On June 27, 1907, the station was moved to a point about one-half mile above its former position. It is now located about 500 feet below the intake of the Tieton Canal, which has recently been constructed by the United States Reclamation Service, and 15 miles above the mouth of the stream. The river receives no tributaries in the immediate vicinity of the station.

At the former location a vertical staff gage at the cable section was used. At the present location two gages have been used, one 20 feet below the cable from which measurements are made, the other at Weisberger's power plant, 1½ miles downstream. During 1907 and 1908 the measurements were referred to both gages and a rating curve developed for each. From January 1 to April 8, 1909, the powerhouse gage was read, but from a relation curve between the two gages these gage heights were reduced to the datum of the cable gage. On July 28, 1909, a Bristol automatic recording gage was installed at the cable at the same datum as the staff gage there.

As the velocity of the water is rapid, ice does not interfere with the determination of flow during the winter season. Great difficulty has been encountered in obtaining continuous gage observation, as this portion of the country is uninhabited. The conditions at the station are not ideal, but it is believed that the results are as reliable as can be procured under the natural conditions of channel which exist on this stream.

Gage heights for 1909 were furnished by the United States Reclamation Service.

Discharge measurements of Tieton River at headworks near Naches, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 18	Stevens and Allen	89	168	2.78	386
June 4	Gleason and Ray	101	368	4.80	1,690
22	McGlashan and Harris	97	295	4.10	1,090
July 1	Gleason and Ray	96	236	3.82	880
8	Howard Kimble	94	244	3.70	825
Aug. 9	Richie Ray	90	174	2.87	408
Sept. 20	Howard Kimble	89	151	2.80	350

Daily gage height, in feet, of Tieton River at headworks near Naches, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.45	2.60	2.80	3.25	3.50	4.95	3.82	3.14	2.74	2.45	2.38	5.10
2	2.40	2.52	2.60	3.25	3.60	5.40	3.85	2.99	2.77	2.42	4.50	4.60
3	2.40	2.60	2.50	3.18	4.00	5.20	3.80	2.99	2.86	2.38	5.48	4.25
4	2.50	2.50	2.55	3.10	4.45	5.00	.....	3.04	2.87	2.37	4.50	4.02
5	2.45	2.50	2.45	3.00	4.10	4.80	3.80	2.89	2.85	2.38	3.72	3.88
6	2.15	2.50	2.50	3.05	4.00	4.50	3.75	2.82	2.87	2.70	.....	3.75
7	2.10	2.45	2.45	3.05	3.90	4.45	3.71	2.82	2.85	2.52	3.25	3.65
8	2.05	2.45	2.45	3.05	3.00	4.30	3.80	2.84	2.75	2.44	3.22	3.60
9	2.30	2.45	2.45	3.15	3.75	4.25	3.70	2.86	2.73	2.66	3.16	3.55
10	2.35	2.40	2.38	3.15	3.75	4.40	3.67	2.89	2.70	2.70	3.05	3.43
11	2.60	2.40	2.45	3.20	3.60	4.60	3.66	2.82	2.55	2.60	2.95	3.35
12	2.40	2.42	2.50	3.40	3.50	4.65	3.62	2.79	2.52	2.55	2.85	3.98
13	2.60	2.45	2.60	3.50	3.50	3.50	3.50	2.82	2.60	2.58	2.85	3.80
14	2.50	2.45	2.70	3.35	3.65	4.00	3.50	2.84	2.42	2.50	2.68	3.64
15	2.70	2.40	2.80	3.25	3.70	4.60	3.45	2.82	2.60	2.40	2.58	3.52
16	3.05	2.50	2.80	3.20	3.80	4.70	3.40	2.71	2.60	2.44	2.62	3.44
17	3.00	2.78	2.83	3.15	3.85	4.50	3.38	2.74	2.52	2.38	2.62	3.37
18	2.70	2.70	2.85	3.08	3.75	4.60	3.22	2.71	2.48	2.35	4.15	3.30
19	2.90	2.55	2.80	3.05	3.70	4.45	3.20	2.84	2.48	2.35	5.35	3.25
20	3.70	2.55	2.80	3.05	3.75	4.30	3.18	2.88	2.68	2.35	4.28	3.22

Daily gage height, in feet, of Tieton River at headworks near Naches, Wash., in 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	3.40	2.50	2.80	3.03	3.76	4.25	3.20	2.80	2.75	2.33	3.85	3.14
22	3.05	2.45	2.75	3.01	3.65	4.10	3.32	2.68	2.53	2.33	4.78	3.06
23	2.90	2.55	2.75	3.15	3.65	4.05	3.40	2.66	2.56	2.31	6.90	3.01
24	2.90	2.45	2.80	3.20	3.75	3.95	3.30	2.66	2.48	2.38	6.80	3.13
25	2.72	2.45	2.94	3.20	3.90	3.90	3.29	2.62	2.60	2.28	5.30	3.17
26	2.67	2.47	3.20	3.80	3.90	3.90	3.15	2.94	2.55	2.30	4.80	3.14
27	2.70	2.45	3.35	3.70	4.15	4.15	3.15	2.87	2.47	2.28	4.18	3.15
28	2.60	2.50	3.25	3.70	3.80	3.80	3.27	2.68	2.52	2.25	4.70	3.21
29	2.56	.....	3.35	3.50	3.75	3.75	3.22	2.67	2.63	2.25	5.50	3.27
30	2.65	.....	3.25	3.40	3.80	3.80	3.25	2.73	2.52	2.30	6.00	3.44
31	2.62	.....	3.25	.....	.....	.....	3.20	2.73	.....	2.30	.....	3.48

NOTE.—Jan. 4 to 11, gage heights believed to be inaccurate; Jan. 1 to Apr. 8, gage heights obtained by means of a relation curve between the power plant gage and the cable gage; July 28 to end of year, gage heights obtained from an automatic gage at same datum as cable gage.

Daily discharge, in second-feet, of Tieton River at headworks near Naches, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	248	300	380	598	735	1,900	883	510	323	214	191	1,780
2	230	272	300	598	790	2,450	902	436	336	204	1,410	1,320
3	230	300	265	560	1,030	2,190	870	436	377	191	2,560	1,060
4	230	265	282	520	1,380	1,950	870	460	382	188	1,410	913
5	230	265	248	470	1,100	1,730	870	390	372	191	822	828
6	230	265	265	495	1,030	1,410	840	359	382	305	694	752
7	230	248	248	495	970	1,360	816	359	372	237	565	698
8	230	248	248	495	1,030	1,230	870	368	328	210	550	670
9	230	248	248	545	880	1,190	810	377	318	289	520	645
10	230	230	224	545	880	1,320	792	390	305	305	465	585
11	230	230	248	570	790	1,510	786	359	248	265	418	548
12	230	237	265	680	735	1,560	762	346	237	248	372	888
13	300	248	300	735	735	1,410	695	359	265	258	372	780
14	265	248	340	652	820	1,000	695	368	204	230	297	692
15	340	230	380	598	850	1,510	668	359	265	197	258	630
16	495	265	380	570	910	1,620	640	310	265	210	273	590
17	470	372	394	545	940	1,410	630	323	227	191	273	556
18	340	340	402	510	880	1,510	550	310	223	182	1,110	525
19	425	282	380	495	850	1,360	540	368	223	182	2,380	502
20	850	282	380	495	880	1,230	530	386	297	182	1,210	489
21	680	265	380	485	886	1,190	540	350	328	176	902	456
22	495	248	360	475	820	1,070	600	297	240	176	1,710	424
23	425	282	360	545	820	1,040	640	289	251	170	4,970	404
24	425	248	380	570	880	968	590	289	223	191	4,600	452
25	348	248	443	570	970	935	585	273	265	161	2,010	468
26	328	254	570	910	970	935	515	413	248	167	1,490	456
27	340	248	652	850	1,140	1,110	515	382	220	161	1,020	460
28	300	265	598	850	910	870	575	297	237	152	1,400	484
29	286	.....	652	735	880	840	550	293	277	152	2,280	512
30	320	.....	598	680	910	870	565	318	237	167	3,050	590
31	308	.....	598	.....	1,400	.....	540	318	.....	167	.....	610

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to June 2, well defined between 230 and 1,730 second-feet; June 3 to Nov. 23, fairly well defined between 350 and 1,730 second-feet; Nov. 24 to Dec. 31, fairly well defined between 900 and 1,680 second-feet; Jan. 4 to 11, discharges estimated.

Monthly discharge of Tieton River at headworks near Naches, Wash., for 1909.

[Drainage area, 247 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total acre-feet.	
January	850	230	339	1.37	1.58	20,800	B.
February	372	230	265	1.07	1.11	14,700	B.
March	652	224	380	1.54	1.78	23,400	B.
April	910	470	595	2.41	2.69	35,400	A.
May	1,400	735	929	3.76	4.34	57,100	A.
June	2,450	840	1,360	5.51	6.15	80,900	A.
July	902	515	685	2.77	3.19	42,100	A.
August	510	273	358	1.45	1.67	22,000	B.
September	382	204	283	1.15	1.28	16,800	B.
October	305	152	204	.826	.95	12,500	B.
November	4,970	191	1,320	5.34	5.96	78,600	B.
December	1,780	404	670	2.71	3.12	41,200	B.
The year	4,970	152	616	2.49	33.82	446,000	

TIETON RIVER AT COBB'S RANCH, NEAR NACHES, WASH.[1]

This station, which affords data of value in connection with the general scheme of the Reclamation Service to develop for irrigation the Yakima River drainage basin, has been located at various points. From April 24, 1902, to March 7, 1906, it was located just below the mouth of Oak Creek on Cobb's ranch. On the latter date it was moved to a point 200 feet above the mouth of Oak Creek, thus excluding 19 square miles of drainage area. On March 23, 1907, it was moved to the highway bridge at camp No. 1 of the United States Reclamation Service; at this point it was between the intake and tailrace of the power canal which furnished electric power for construction of two large tunnels on the Tieton canal; no attempt to determine discharges was made while the plant was in operation. On April 14, 1909, the station was established at Cobb's ranch, below the mouth of Oak Creek, a short distance downstream from the point where it was first located on April 24, 1902.

The gage is an inclined staff bolted to solid rock on the left bank 100 feet upstream from the cable. Measurements are made from a standard cable equipment. The bed and banks of the stream are solid basalt and will not change. The right bank has a gentle slope and is lightly covered with soil and is timbered to almost the water's edge.

During 1909 the flow of water at this station was affected to a small degree by the operation of the power plant at camp No. 1, although the station is below the tailrace of the plant.

[1] This station called "Tieton River near Naches" in Water-Supply Paper 252, p. 180.

Discharge measurements of Tieton River at Cobb's ranch, near Naches, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 11	H. D. McGlashan	78	167	4.94	536
June 4	Gleason and Ray	85	318	6.85	1,980
21	McGlashan and Harris	83	237	6.00	1,210
July 6	H. Kimble	83	204	5.60	1,030
29	Gleason and Ray	78	155	4.90	550
Aug. 6	Howard Kimble	66	138	4.58	370
Sept. 18	do	62	111	4.15	213
Nov. 23	do	125	670	10.50	7,290

Daily gage height, in feet, of Tieton River at Cobb's ranch, near Naches, Wash., for 1909.

[Mrs. Parmentier and Matt Hagerty, observers.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	5.2	6.8	5.2	.....	4.4	4.1	4.0	6.8
2	.....	5.5	7.5	5.4	.....	4.5	4.1	6.0	6.5
3	.....	5.8	7.3	5.4	.....	4.6	4.1	7.5	6.2
4	.....	6.2	7.0	5.3	.....	4.6	4.0	6.4	5.9
5	.....	6.0	6.2	5.5	.....	4.6	4.0	6.0	5.7
6	.....	5.7	6.4	5.6	4.6	4.6	4.2	5.4	5.6
7	.....	5.5	6.5	5.5	4.6	4.6	4.3	5.0	5.4
8	.....	5.5	6.5	.....	4.6	4.5	4.3	4.9	5.1
9	.....	5.5	6.5	.....	4.6	4.5	4.2	4.8	4.9
10	.....	5.5	6.4	.....	4.7	4.5	4.3	4.7	5.0
11	.....	5.4	6.5	.....	4.6	4.3	4.3	4.6	5.2
12	.....	5.3	6.6	.....	4.6	4.2	4.3	4.6	5.8
13	.....	5.5	6.6	.....	4.6	4.4	4.3	4.5	5.6
14	.....	5.5	6.5	.....	4.6	4.3	4.3	4.4	5.4
15	.....	5.6	6.5	.....	4.5	4.3	4.1	4.3	5.3
16	.....	5.6	6.5	.....	4.5	4.4	4.1	4.1	5.2
17	.....	5.6	6.5	.....	4.6	4.3	4.1	4.1	5.1
18	.....	5.5	6.4	.....	4.6	4.2	4.1	5.1	5.1
19	.....	5.5	6.4	.....	4.7	4.1	4.1	6.5	5.0
20	.....	5.5	6.2	.....	4.6	4.2	4.0	6.3	4.9
21	5.0	5.5	6.2	.....	4.6	4.5	4.0	5.8	4.8
22	5.0	5.6	6.1	.....	4.5	4.3	4.0	7.5	4.7
23	5.0	5.6	6.2	.....	4.5	4.1	4.0	10.3	4.6
24	5.1	5.7	6.1	.....	4.5	4.1	4.0	10.5	4.6
25	5.2	5.8	6.0	.....	4.4	4.2	4.1	7.9	.....
26	5.8	6.0	5.9	.....	4.8	4.2	4.0	6.7	4.4
27	5.4	6.0	5.8	.....	4.6	4.2	4.0	6.2	4.4
28	5.4	6.0	5.5	.....	4.4	4.2	3.9	5.9	4.4
29	5.3	6.1	5.4	.....	4.4	4.3	3.9	7.2	4.3
30	5.2	6.1	5.2	.....	4.5	4.2	4.0	8.5	4.3
31	.....	6.2	.....	.....	4.5	.....	4.0	.....	4.3

NOTE.—Gage heights unaffected by ice.

Daily discharge, in second-feet, of Tieton River at Cobb's ranch, near Naches, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	705	1,940	705	500	300	205	180	1,870
2	.....	900	2,640	830	480	340	205	1,260	1,610
3	.....	1,110	2,420	830	460	385	205	2,640	1,360
4	.....	1,420	2,120	765	430	385	180	1,580	1,120
5	.....	1,260	1,420	900	410	385	180	1,260	980
6	.....	1,040	1,580	970	385	385	230	830	910
7	.....	900	1,670	900	385	385	260	585	770
8	.....	900	1,670	900	385	340	260	525	580
9	.....	900	1,670	830	385	340	230	475	465
10	.....	900	1,580	830	430	340	260	430	520

Daily discharge, in second-feet, of Tieton River at Cobb's ranch, near Naches, Wash., for 1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	830	1,670	830	385	260	260	385	640
12	.....	765	1,760	765	385	230	260	385	1,050
13	.....	900	1,760	705	385	300	260	340	910
14	.....	900	1,670	705	385	260	260	300	770
15	.....	970	1,670	705	340	260	205	260	705
16	.....	970	1,670	645	340	300	205	205	640
17	.....	970	1,670	645	385	260	205	205	580
18	.....	900	1,580	525	385	230	205	1,040	580
19	.....	900	1,580	525	430	205	205	1,670	520
20	.....	900	1,420	525	385	230	180	1,500	465
21	585	900	1,420	525	385	340	180	1,110	410
22	585	970	1,340	585	340	260	180	2,640	360
23	585	970	1,420	645	340	205	180	6,930	315
24	645	1,040	1,340	585	340	205	180	7,290	315
25	705	1,110	1,260	585	300	230	205	3,030	278
26	1,110	1,260	1,180	525	475	230	180	1,780	240
27	830	1,260	1,110	475	385	230	180	1,360	240
28	830	1,260	900	475	300	230	156	1,120	240
29	765	1,340	830	525	300	260	156	2,250	210
30	705	1,340	705	530	340	230	180	3,850	210
31	.....	1,420	.....	520	340	.....	180	.....	210

NOTE.—These discharges are based on rating curves applicable as follows: Apr. 21 to Nov. 24, well defined between 200 and 7,300 second-feet; Nov. 25 to Dec. 31, well defined between 300 and 2,050 second-feet. Discharges July 8 to 28 obtained by hydrograph comparison with the station at headworks. Discharges interpolated July 30 to Aug. 5.

Monthly discharge of Tieton River at Cobb's ranch, near Naches, Wash., for 1909.

[Drainage area, 289 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April 21–30	1,110	585	734	2.54	0.94	14,600	A.
May	1,420	705	1,030	3.56	4.10	63,300	A.
June	2,640	705	1,560	5.39	6.01	92,800	A.
July	.....	475	678	2.35	2.71	41,700	C.
August	.....	300	384	1.33	1.53	23,600	B.
September	385	205	285	.986	1.10	17,000	A.
October	260	156	207	.716	.83	12,700	A.
November	7,290	180	1,580	5.47	6.10	94,000	B.
December	1,870	210	648	2.24	2.58	39,800	A.
The period	.....	.....	.....	.....	.....	400,000	

ATANUM CREEK DRAINAGE BASIN.

DESCRIPTION.

Atanum Creek is formed by the union of North and South forks, in Yakima County, near Tampico, Wash. It flows eastward, joining Yakima River about 10 miles below the mouth of Naches River. The creek and its South Fork make the greater part of the northern boundary of the Yakima Indian Reservation. Its waters are extensively used for the irrigation of Indian lands on the south side and for lands belonging to the white settlers on the north. Throughout the lower portion of the stream it receives considerable return water from this irrigation.

NORTH FORK OF ATANUM CREEK NEAR TAMPICO, WASH.

This station, which is located on the North Fork at Goodman's ranch, 3 miles above Tampico, Wash., 3½ miles above the junction with South Fork, and 100 feet below the mouth of Nasty Creek, was established August 26, 1907, to determine the low-water flow available for irrigation. It is above all diversions from the stream.

The vertical staff gage is spiked to a small cottonwood tree on the left bank.

The conditions at the station are not favorable for very accurate results. The current is swift and there were no facilities for making measurements except by wading until 1910, when a cable was installed. An estimate of the flow at higher stages has been made by extending the discharge curve parallel to the 1910 curve.

The records at the station are not complete, as it was impossible to obtain continuous observation of gage height.

Discharge measurements of North Fork of Atanum Creek near Tampico, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 25	J. C. Stevens	32	50	2.25	131
July 15	Kimble and Ray	29	30	1.70	57
Sept. 29	H. Kimble	27	21	1.40	24

Daily gage heights, in feet, of North Fork of Atanum Creek near Tampico, Wash., for 1909.
[Geo. Prior, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		2.75	2.05	1.5	1.35			
2		2.85	2.0	1.5	1.35			
3		2.7	2.0	1.5	1.35			
4		2.6	1.95	1.5	1.35			
5		2.55	1.95	1.5	1.3			
6		2.5	2.05	1.5	1.3			
7		2.45			1.25			1.9
8		2.45		1.45	1.2			1.95
9		2.4		1.45	1.25			2.0
10		2.45		1.4	1.25			2.0
11		2.5	1.53	1.4	1.25			2.0
12		2.45	1.5	1.4				2.0
13		2.4	1.2	1.4		1.25		1.98
14		2.4	1.6	1.4				1.9
15		2.4	1.8					1.9
16		2.4	1.7					1.8
17		2.4	1.7					1.78
18		2.4	1.7					1.75
19		2.35	1.65					1.7
20		2.3	1.65					1.7
21		2.3	1.6				1.78	1.7
22		2.2	1.6	1.4			1.85	1.65
23		2.2	1.6	1.4				1.65
24		2.2	1.6	1.4				1.65
25	2.25	2.2	1.6	1.4				1.65
26	2.4	2.2	1.65	1.4				1.65
27	2.5	2.2	1.6	1.4				1.65
28	2.52	2.2	1.5	1.4				1.65
29	2.4	2.15	1.55	1.36	1.4			1.65
30	2.45	2.1	1.6	1.36				1.65
31	2.4			1.35				1.68

NOTE.—Observations resumed May 25. Sept. 12 to Dec. 6 no observations; observer absent. Dec. 7 observations resumed.

Daily discharge, in second-feet, of North Fork of Atanum Creek near Tampico, Wash., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.								
1	.....	314	108	35	24	17	20	180
2	.....	361	99	35	24	17	50	160
3	.....	292	99	35	24	17	40	150
4	.....	251	91	35	24	17	35	140
5	.....	232	91	35	20	17	35	120
6	.....	214	108	35	20	17	35	100
7	.....	199	94	33	17	17	35	106
8	.....	199	80	31	14	17	35	116
9	.....	184	66	31	17	17	35	125
10	.....	199	52	27	17	17	30	125
11	.....	214	38	27	17	17	30	125
12	.....	199	35	27	18	17	30	125
13	.....	184	37	27	18	17	30	121
14	.....	184	45	27	19	17	25	106
15	.....	184	69	27	19	17	20	106
16	.....	184	57	27	20	17	20	90
17	.....	184	57	27	20	17	30	87
18	.....	184	57	27	21	17	35	82
19	.....	171	51	27	21	17	40	75
20	.....	158	51	27	22	17	50	75
21	.....	158	45	27	23	17	67	75
22	.....	135	45	27	23	17	76	68
23	.....	135	45	27	24	17	150	68
24	.....	135	45	27	24	17	350	68
25	146	135	45	27	25	17	250	68
26	184	135	51	27	25	17	200	68
27	214	135	45	27	26	17	180	68
28	221	135	35	27	26	17	160	68
29	184	126	40	24	27	17	180	68
30	184	116	45	24	22	17	200	68
31	184	.....	40	24	.....	17	.....	72

NOTE.—These discharges for 1909 are based on a rating curve that is fairly well defined. Discharges for days having no gage records in the periods covered are interpolated except as noted: Oct. 1 to 31, mean discharge estimated as 17 second-feet, as the observer noted the gage height remained practically constant during the month. Discharges for November and Dec. 1 to 6, estimated by intercomparisons and hydrograph studies of the stations maintained in Atanum Creek and its tributaries.

Monthly discharge of North Fork of Atanum Creek near Tampico, Wash., for 1909.

[Drainage area, 66 square miles].

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1909.							
May 25-31	221	146	188	2.85	.74	2,610	A.
June	361	116	188	2.85	3.18	11,200	A.
July	108	35	60.2	.912	1.05	3,700	A.
August	35	24	28.7	.435	.50	1,760	B.
September	27	14	21.4	.324	.36	1,270	C.
October	17	17	17.0	.258	.30	1,050	C.
November	350	20	82.4	1.25	1.40	4,900	C.
December	180	68	99.1	1.50	1.73	6,090	B.
The period	.....	.....	.....	.....	.....	32,600	.

ATANUM CREEK AT THE NARROWS, NEAR TAMPICO, WASH.

This station was established June 25, 1908. It is located at a point in the river locally known as "The Narrows," 3½ miles east of Tampico, Wash., and 3 miles below the junction of North and South forks.

The vertical gage is on the right bank near the highway about 100 feet above a ford. The flow here is assumed to include all return waters from irrigation in the upper part of the drainage basin; but the correctness of this assumption is very doubtful, as the situation is greatly complicated by an innumerable number of small ditches both above and below the station. The records should not therefore be considered to represent the natural run-off from this drainage area. Gagings are made from a car and cable equipment.

Discharge measurements of Atanum Creek at The Narrows, near Tampico, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 26	L. R. Allen	27	38	1.10	49.
May 25	J. C. Stevens	27.5	56	1.79	159
July 15	H. Kimble	28	40	1.20	65
Sept. 29	do	28	32.4	.90	24.9

Daily gage heights, in feet, of Atanum Creek at The Narrows, near Tampico, Wash., for 1909.

[F. H. Alm and Fred B. Dye, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.95	1.02	1.15	1.70	1.60	2.35	1.45	.....	0.88	0.90	0.90	2.18
2	.96	1.02	1.12	1.65	.....	2.58	1.42	0.95	.88	.90	1.32	2.00
3	.98	1.02	1.25	1.60	1.85	2.53	1.40	.96	.88	.....	1.20	1.95
4	.98	1.00	.....	1.57	2.10	2.40	1.40	.95	.88	.90	1.10	1.95
5	.82	1.00	.....	1.52	1.95	2.35	1.40	.93	.....	.90	1.10	.....
6	.85	1.00	.....	1.45	1.82	2.25	1.45	.91	.....	.90	1.06	1.85
7	.....	1.00	1.20	1.43	1.75	2.15	1.42	.90	.88	.90	.....	1.85
8	.....	1.00	1.18	1.40	1.73	2.05	1.40	.....	.88	.90	1.10	1.75
9	.....	1.00	.....	1.45	1.75	2.05	1.37	.90	.88	.90	1.06	1.65
10	.....	1.02	1.25	1.52	1.75	1.95	1.35	.90	.88	.....	1.05	1.65
11	1.10	.98	1.50	1.55	1.70	2.05	1.35	.90	.88	.90	1.04	1.65
12	1.30	.98	1.55	1.58	1.70	2.08	1.27	.90	.....	.90	1.01	.....
13	.....	1.00	1.50	.....	1.70	1.95	1.25	.90	.88	.90	1.00	1.53
14	1.20	1.00	1.45	1.68	1.78	1.95	1.20	.91	.88	.89	.....	1.50
15	.....	.98	1.60	1.65	1.78	.....	1.20	.....	.87	.89	.90	1.50
16	.....	1.00	1.58	1.60	1.85	2.05	1.20	.90	.86	.89	.90	1.48
17	.98	1.13	1.60	1.58	1.85	2.05	1.19	.89	.86	.....	1.00	1.45
18	1.00	1.13	1.58	1.55	1.85	2.03	.....	.90	.87	.89	1.15	1.45
19	1.10	1.10	1.55	1.50	1.87	1.95	1.10	.90	.....	.89	1.53	.....
20	1.38	1.13	1.50	1.53	1.82	1.95	1.08	.89	.88	.90	1.48	1.42
21	1.40	1.12	1.45	1.53	1.82	1.80	1.03	.89	.89	.90	.....	1.42
22	.....	1.10	1.40	1.55	1.75	1.80	1.00	.....	.90	.90	1.90	1.41
23	1.16	1.10	1.40	.....	1.75	1.75	1.00	.89	.90	.90	2.50	1.40
24	1.16	1.15	1.45	1.58	1.75	1.73	1.00	.89	.90	.....	2.88	1.39
25	1.16	1.20	1.53	1.62	1.78	1.70	.....	.89	.90	.89	.....	1.40
26	.....	1.20	1.58	1.70	.....	1.62	.97	.89	.....	.89	2.35	.....
27	.98	.....	1.68	1.68	2.15	1.65	1.00	.90	.89	.89	2.05	1.41
28	1.02	1.10	1.75	1.65	2.15	1.55	1.00	.90	.89	.89	.....	1.40
29	1.00	.....	1.78	1.58	2.08	1.48	1.00	.....	.90	.89	1.95	1.40
30	1.04	.....	1.70	1.58	2.05	1.50	.99	.89	.90	.90	2.28	1.40
31	1.02	.....	1.67	.....	2.10	.....	.95	.89	.....	.....	.....	1.40

NOTE.—Channel frozen Jan. 7 to 18. Gage readings are to water surface. Ice along edges and at gage from Jan. 26 to Feb. 17.

Daily discharge, in second-feet, of Atanum Creek at The Narrows, near Tampico, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	30	37	52	150	130	314	100	30	23	25	25	262
2	31	37	49	140	156	393	95	30	23	25	77	216
3	33	37	66	130	183	375	91	31	23	25	59	205
4	33	35	64	124	240	330	91	30	23	25	46	205
5	19	35	62	114	205	314	91	28	23	25	46	194
6	21	35	61	100	176	283	100	26	23	25	42	183
7	21	35	59	97	161	254	95	25	23	25	44	183
8	25	35	56	91	157	228	91	25	23	25	46	161
9	29	35	61	100	161	228	86	25	23	25	42	140
10	33	37	66	114	161	205	82	25	23	25	40	140
11	37	33	110	120	150	228	82	25	23	25	39	140
12	59	33	120	126	150	235	70	25	23	25	36	128
13	53	35	110	136	150	205	66	25	23	25	35	116
14	47	35	100	146	168	205	59	26	23	24	30	110
15	40	33	130	140	168	216	59	26	23	24	25	110
16	33	35	126	130	183	228	59	25	22	24	25	106
17	26	50	130	126	183	228	58	24	22	24	35	100
18	28	50	126	120	183	223	52	25	23	24	52	100
19	46	46	120	110	187	205	46	25	23	24	116	98
20	88	50	110	116	176	205	44	24	23	25	106	95
21	91	49	100	116	176	172	38	24	24	25	150	95
22	72	46	91	120	161	172	35	24	25	25	194	93
23	54	46	91	123	161	161	35	24	25	25	364	91
24	54	52	100	126	161	157	35	24	25	24	512	89
25	54	59	116	134	168	150	34	24	25	24	413	91
26	44	59	126	150	211	134	32	24	24	24	314	92
27	33	52	146	146	254	140	35	25	24	24	228	93
28	37	46	161	140	254	120	35	25	24	24	216	91
29	35	.....	168	126	235	106	35	24	25	24	205	91
30	39	.....	150	126	228	110	34	24	25	25	292	91
31	37	.....	144	.....	240	.....	30	24	.....	25	.....	91

NOTE.—These discharges, except for frozen period, are based on a rating curve that is well defined between discharges 25 and 190 second-feet. Discharges Jan. 7 to 18 reduced 20 per cent from open-water rating to allow for ice conditions. Discharges interpolated for days having no gage record.

Monthly discharge of Atanum Creek at The Narrows, near Tampico, Wash., for 1909.

[Drainage area, 116 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	91	19	41.5	0.358	0.41	2,550	B.
February	59	33	41.7	.359	.37	2,320	B.
March	168	49	102	.88	1.01	6,270	A.
April	150	91	125	1.08	1.20	7,440	A.
May	254	130	183	1.58	1.82	11,300	A.
June	393	106	217	1.87	2.09	12,900	A.
July	100	30	61.1	.527	.61	3,760	A.
August	31	24	25.5	.220	.25	1,570	B.
September	25	22	23.5	.203	.23	1,400	B.
October	25	24	24.6	.212	.24	1,510	B.
November	512	25	128	1.10	1.23	7,620	A.
December	262	89	129	1.11	1.28	7,930	A.
The year	512	19	91.8	.792	10.74	66,600	

ATANUM CREEK NEAR YAKIMA, WASH.

This station was established May 11, 1904, at the Northern Pacific Railway bridge about 1 mile southeast of Yakima, Wash., and was discontinued December 30, 1904. Observations were again resumed August 27, 1907, at the same point. The present vertical staff gage is located just above the Northern Pacific Railway bridge, and the measurements are made from the bridge during high water and by wading at low water.

The data obtained at this point are valuable in connection with a general study of the reclamation of the Yakima Valley now in progress by the United States Reclamation Service.

The conditions at this station are unfavorable for accurate results and the gage readings are not sufficiently trustworthy to warrant their publication. The water at the gage is considerably disturbed by riffles. No ice forms to interfere with the determination of discharges.

Discharge measurements of Atanum Creek near Yakima, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 25[a]	L. R. Allen	22	29	3.96	48
Mar. 13[a]	do	21.4	33.2	4.46	101
May 5[b]	H. D. McGlashan	32	42	4.41	82
June 14[b]	H. Kimble	12	14.5	3.57	20.5
Sept. 24[b]	do	12	11.4	3.35	10.8

[a] Made at regular station. [b] Made by wading just above station.

SOUTH FORK OF ATANUM CREEK NEAR TAMPICO, WASH.

This station, which is located at Shannafelt's ranch, 2 miles above Tampico, Wash., and 2½ miles above the junction with the North Fork of Atanum Creek, was established August 27, 1907, to obtain data for use in connection with irrigation in Yakima Valley. It is above all diversions except two small ditches that take water for individual tracts of land above the station.

The banks of the stream are very thickly covered with willows and brush and the channel is not permanent. The vertical staff gage is on the right bank about 500 feet below the observer's house. Measurements are made by wading at low stages in the vicinity of the gage or from a private bridge one-fourth mile below. There is a small by-channel whose waters do not pass the gage, but are measured at the bridge. During high stages in the summer time the brush on the banks of the stream cause a backwater effect that is not noticeable in the spring and winter, when the leaves are not on the trees.

Discharge measurements of South Fork of Atanum Creek near Tampico, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 27	L. R. Allen	14	5.0	1.34	8.4
May 25 *a*	J. C. Stevens	6.4	9.2	1.87	35
July 16	Kimble and Ray	13.7	5.6	1.28	7.8
Sept. 29	H. Kimble	13	4.3	1.15	4.3

a South channel carried 1.5 second-feet.

Daily gage heights, in feet, of South Fork of Atanum Creek near Tampico, Wash., for 1909.

[E. A. Shannafelt, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.2	1.3	1.45	1.95	1.7	3.1	1.5	1.2	1.16	1.15	1.2	2.4
2	1.25	1.3	1.45	1.9	1.8	4.5	1.45	1.2	1.16	1.15	1.5	2.2
3	1.25	1.35	1.45	1.85	1.95	4.75	1.45	1.2	1.15	1.15	1.3	.....
4	1.25	1.35	1.5	1.8	2.1	4.85	1.45	1.2	1.15	1.15	1.3	2.2
5	1.2	1.4	1.5	1.8	2.0	2.85	1.4	1.2	1.15	1.15	1.4	.....
6	1.2	1.4	1.55	1.7	1.95	2.75	1.4	1.2	1.15	1.15	1 25	2.0
7	1.2	1.3	1.55	1.7	1.9	2.3	.....	1.2	1.15	1.15	1.25	1.9
8	1.2	1.3	1.5	1.6	1.9	2.1	.....	1.2	1.15	1.15	1.3	1.8
9	1.2	1.3	1.55	1.6	1.85	2.05	.....	1.2	1.15	1.15	1.3	1.8
10	1.2	1.3	1.55	1.7	1.8	2.0	.....	1.2	1.15	1.15	1.25	.....
11	1.2	1.3	1.55	1.7	1.8	2.0	.....	1.2	1.15	1.15	1.25	1.8
12	1.25	1.3	1.6	1.8	1.8	2.1	.....	1.2	1.14	1.15	1.25	1.8
13	1.2	1.35	1.7	1.8	1.8	1.98	.....	1.2	1.14	1.15	1.25	1.8
14	1.2	1.3	1.85	1.85	1.85	1.9	.....	1.2	1.14	1.15	1.22	1.8
15	1.2	1.3	1.9	1.9	1.9	1.9	.....	1.2	1.14	1.15	1.2	1.7
16	1.25	1.3	1.9	1.85	1.9	1.9	1.3	1.2	1.14	1.15	1.25	1.6
17	1.25	1.4	1.9	1.8	1.9	1.9	1.3	1.2	1.14	1.15	1.3	1.6
18	1.25	1.4	1.85	1.75	1.9	1.85	1.3	1.19	1.15	1.15	1.5	1.6
19	1.55	1.45	1.8	1.7	1.9	1.8	1.27	1.2	1.15	1.15	1.5	1.6
20	1.8	1.5	1.8	1.7	1.85	1.8	1.28	1.2	1.18	1.15	1.55	1.55
21	1.7	1.5	1.8	1.65	1.8	1.75	1.28	1.19	1.18	1.18	1.45	1.52
22	1.6	1.5	1.75	1.65	1.85	1.75	1.28	1.19	1.16	1.17	1.6	1.5
23	1.3	1.45	1.75	1.7	1.85	1.7	1.27	1.19	1.16	1.18	1.7	1.5
24	1.3	1.45	1.7	1.7	1.85	1.7	1.25	1.19	1.15	1.18	3.3	1.5
25	1.3	1.45	1.8	1.75	1.87	1.65	1.25	1.19	1.16	1.18	2.7	1.5
26	1.3	1.45	1.85	1.8	1.98	1.7	1.23	1.19	1.15	1.18	2.2	1.5
27	1.3	1.45	1.9	1.85	2.1	1.65	1.25	1.19	.....	1.18	1.9	1.5
28	1.3	1.45	2.05	1.85	2.1	1.6	1.22	1.19	.....	1.18	1.95	1.5
29	1.3	.....	2.05	1.8	2.15	1.55	1.22	1.18	1.15	1.19	2.0	1.5
30	1.3	.....	1.95	1.75	2.1	1.55	1.22	1.17	1.15	1.19	2.4	1.45
31	1.3	.....	1.9	.....	2.1	.....	1.22	1.16	.....	1.20	.....	1.45

NOTE.—Gage heights June 1 to 6 affected by backwater, as the channel is contracted by thick deciduous brush on banks.

Ice conditions Jan. 8 to 18 and Dec. 23 to 31, during which periods the channel was almost closed.

Daily discharge, in second-feet, of South Fork of Atanum Creek near Tampico, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	7.5	13	43	26	90	15	5.0	4.4	4.3	5.0	88
2	6.2	7.5	13	39	32	150	13	5.0	4.4	4.3	15	66
3	6.2	9.2	13	36	43	140	13	5.2	4.3	4.3	7.5	66
4	6.2	9.2	15	32	56	120	13	5.0	4.3	4.3	7.5	66
5	5.0	11	15	32	47	110	11	5.0	4.3	4.3	11	56
6	5.0	11	18	26	43	90	11	5.0	4.3	4.3	6.2	47
7	5.0	7.5	18	26	39	77	11	5.0	4.3	4.3	6.2	39
8	4.5	7.5	15	20	39	56	10	5.0	4.3	4.3	7.5	32
9	4.5	7.5	18	20	36	52	10	5.0	4.3	4.3	7.5	32
10	4.5	7.5	15	26	32	47	9.6	5.0	4.3	4.3	6.2	32

Daily discharge, in second-feet, of South Fork of Atanum Creek near Tampico, Wash., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	4.5	7.5	20	26	32	47	9.2	5.0	4.3	4.3	6.2	32
12	5.6	7.5	26	32	32	56	8.9	5.0	4.2	4.3	6.2	32
13	4.5	9.2	36	32	32	45	8.6	5.0	4.2	4.3	6.2	32
14	4.5	7.5	18	36	36	39	8.2	5.0	4.2	4.3	5.5	32
15	4.5	7.5	39	39	39	39	7.8	5.0	4.2	4.3	5.0	26
16	5.6	7.5	39	36	39	39	7.5	5.0	4.2	4.3	6.2	20
17	5.6	11	39	32	39	39	7.5	5.0	4.2	4.3	7.5	20
18	5.6	11	36	29	39	36	7.5	4.9	4.3	4.3	15	20
19	18	13	32	26	39	32	6.8	5.0	4.3	4.3	15	20
20	32	15	32	26	36	32	7.0	5.0	4.7	4.3	18	18
21	26	15	32	23	32	29	7.0	4.9	4.7	4.7	13	16
22	20	15	29	23	36	29	7.0	4.9	4.4	4.6	20	15
23	7.5	13	29	26	36	26	6.8	4.9	4.4	4.7	26	14
24	7.5	13	26	26	36	26	6.2	4.9	4.3	4.7	211	14
25	7.5	13	32	29	37	23	6.2	4.9	4.3	4.7	126	14
26	7.5	13	36	32	45	26	5.8	4.9	4.3	4.7	66	14
27	7.5	13	39	36	56	23	6.2	4.9	4.3	4.7	39	14
28	7.5	13	52	36	56	20	5.5	4.9	4.3	4.7	43	14
29	7.5	.....	52	32	61	18	5.5	4.7	4.3	4.9	47	14
30	7.5	.....	43	29	56	18	5.5	4.6	4.3	4.9	88	12
31	7.5	.....	39	.....	56	.....	5.5	4.4	.....	5.0	.....	12

NOTE.—These discharges are based on a rating curve that is fairly well defined between discharges 4 and 50 second-feet.
Discharges June 1 to 6 estimated by comparison with North Fork and Atanum Creek near Tampico.
Discharges interpolated for days having no gage record.
Discharges Jan. 8 to 18 and Dec. 23 to 31 reduced 10 per cent to compensate for ice conditions.

Monthly discharge of South Fork of Atanum Creek near Tampico, Wash., for 1909.

[Drainage area, 28 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	32	4.5	8.26	0.295	0.34	508	C.
February	15	7.5	10.4	.371	.39	578	B.
March	52	13	28.4	1.01	1.16	1,750	A.
April	43	20	30.2	1.08	1.20	1,800	A.
May	61	26	40.7	1.45	1.67	2,500	A.
June	[a] 150	18	52.5	1.88	2.10	3,120	B.
July	15	5.5	8.48	.303	.35	521	B.
August	5.2	4.4	4.94	.176	.20	304	B.
September	4.7	4.2	4.32	.154	.17	257	B.
October	5.0	4.3	4.46	.159	.18	274	B.
November	211	5.0	28.3	1.01	1.13	1,680	A.
December	88	12	30.0	1.07	1.23	1,840	B.
The year	211	4.2	20.9	.746	10.12	15,100	

[a] Estimated.

TOPPENISH CREEK DRAINAGE BASIN.

DESCRIPTION.

Toppenish Creek, which drains the northern part of the Yakima Indian Reservation, enters Yakima River from the west about 25 miles below the mouth of Atanum Creek. After leaving the hills the creek spreads into innumerable sloughs and it is almost impossible to find a point where all the flow can be measured. Its principal tributary is Simcoe Creek.

The Reclamation Service proposes to divert water from Toppenish Creek near Fort Simcoe to a reservoir on Simcoe Creek.

TOPPENISH CREEK NEAR FORT SIMCOE, WASH.

This station, which is located 3 miles east and about 1 mile south of Fort Simcoe, 1 mile below the highway bridge in sec. 26, T. 10 N., R. 16 E., was established February 27, 1909, to obtain data for use in connection with the project for the irrigation of lands in the Yakima Indian Reservation.

The station is about 8 miles above Simcoe Creek. The gage is of the chain-and-weight type and is attached to a cantilever beam 8 feet downstream from the gaging section on the right bank. Measurements are made from a cable. The right bank is high and rocky and not liable to overflow. The left bank is low and will overflow at high stages. The bed of the stream is of gravel and cobblestones and fairly permanent.

Discharge measurements of Toppenish Creek near Fort Simcoe, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 27	L. R. Allen	31	30	1.60	112
27	do	31	30	1.60	115
Mar. 11	Hews and Merrill	31.5	30.1	1.45	101
18	do	33	49.1	2.20	252
May 25	H. D. McGlashan	35	35	1.72	149
July 17[a]	Kimble and Ray	20.6	15.7	.75	22.3

[a] Made by wading.

Daily gage heights, in feet, of Toppenish Creek near Fort Simcoe, Wash., for 1909.

[R. Harbaugh, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.6		2.9	1.7	0.82	0.52	0.62		1.2	2.82
2		1.6	2.5	2.9	1.6	.82				1.4	2.7
3		1.5	2.6	2.9	1.5	.82	.52	.62	0.92	1.52	2.62
4		1.6	2.7	3.1	1.6	.82			.9	1.52	
5		1.6	2.5	3.1	1.5	.8		.6	.8		2.5
6			2.5	2.8	1.5	.92	.5			1.62	2.42
7		1.4	2.2	2.8	1.5	.92	.5	.6	.8	1.62	2.12
8		1.42	2.4		1.4	.9	.6	.6	.72	1.62	2.1
9		1.42	2.3	2.6	1.3	.92		.6		.92	1.82
10		1.42	2.5	2.6	1.2	.92			.72	.92	1.72
11		1.45	2.5	2.5	1.2	.82	.6	.62	.72	.9	1.72
12		1.4	2.7	2.3	1.2	.8		.62		.82	1.92
13		1.7	2.7	2.1	1.2	.8			.7	.72	1.92
14		1.9	2.9	2.3	1.1	.8	.6	.72	.7		
15		2.1	2.8	2.1	1.1	.8	.6			.72	1.82
16		2.12	2.7	2.2	1.1		.6	.72	.62	.92	1.82
17		2.3	2.7	2.1	1.1	.75			.62	1.22	1.82
18		2.2	2.7	2.1	1.1	.7		.72	.62	1.42	1.84
19		2.1	2.7	2.1	1.04			.7		1.62	1.84
20		2.1	2.7	1.9	1.04				.62	1.76	1.72
21		2.1	2.8	1.8	1.04		.6	.7	.62	1.92	1.72
22		1.9	2.7	1.7	1.02		.62		.64	2.82	
23		1.9	2.7	1.7	1.02	.6	.62	.7	.72	3.62	
24		2.1	2.8	1.8	1.02	.6	.62		.72		1.72
25		2.1	2.8	1.72	1.02	.6		.92	.72		1.72
26	1.6	2.3	2.9		.9				.72	2.92	1.72
27		2.5	2.9	1.7	.9			1.0	.72	2.72	1.72
28	1.6	2.6	2.7	1.7	.84	.6	.6	1.0		2.72	1.72
29		2.7	2.6	1.6	.82	.6	.6	1.0	.92	2.86	1.72
30		2.6	2.7	1.6	.82	.6		.92	.92	2.92	1.72
31		2.6		1.7		.52	.6		.94		1.72

NOTE.—No ice reported.

Daily discharge, in second-feet, of Toppenish Creek near Fort Simcoe, Wash., for 1909.

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	121	334	435	140	26	12	15	34	62	411
2	.....	121	321	435	121	26	12	15	34	88	376
3	.....	104	348	435	104	26	12	15	34	107	354
4	.....	121	376	500	121	26	12	14	32	107	337
5	.....	121	321	500	104	24	12	14	24	116	321
6	.....	104	321	405	104	34	12	14	24	125	301
7	.....	88	249	405	104	34	12	14	24	125	231
8	.....	91	296	376	88	32	14	14	19	125	226
9	.....	91	272	348	74	34	14	14	19	34	164
10	.....	91	321	348	62	34	14	14	19	34	144
11	.....	96	321	321	62	26	14	15	19	32	144
12	.....	88	376	272	62	24	14	15	19	26	185
13	.....	140	376	226	62	24	14	17	18	19	185
14	.....	181	435	272	51	24	14	19	18	19	175
15	.....	226	405	226	51	24	14	19	16	19	164
16	.....	231	376	249	51	22	14	19	15	34	164
17	.....	272	376	226	51	21	14	19	15	64	164
18	.....	249	376	226	51	18	14	19	15	91	168
19	.....	226	376	226	45	17	14	18	15	125	168
20	.....	226	376	181	45	16	14	18	15	152	144
21	.....	226	405	160	45	16	14	18	16	185	144
22	.....	181	376	140	43	15	15	18	15	411	144
23	.....	181	376	140	43	14	15	18	19	683	144
24	.....	226	405	160	43	14	15	26	19	603	144
25	.....	226	405	144	43	14	15	34	19	522	144
26	121	272	435	142	32	14	14	37	19	441	144
27	121	321	435	140	32	14	14	41	19	382	144
28	121	348	376	140	27	14	14	41	26	382	144
29	.....	376	348	121	26	14	14	41	34	423	144
30	.....	348	376	121	26	14	14	34	34	441	144
31	.....	348	.....	140	.....	12	14	.....	36	.....	144

NOTE.—These discharges are based on a rating curve that is well defined between 18 and 250 second-feet. Discharges interpolated for days when the gage was not read.

Monthly discharge of Toppenish Creek near Fort Simcoe, Wash., for 1909.

[Drainage area, 135 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	376	88	195	1.44	1.66	12,000	A.
April	435	249	363	2.69	3.00	21,600	A.
May	500	121	263	1.95	2.25	16,200	A.
June	140	26	63.8	.473	.53	3,800	A.
July	34	12	21.5	.159	.18	1,320	B.
August	15	12	13.7	.101	.12	842	B.
September	41	14	21.0	.156	.17	1,250	B.
October	36	15	22.1	.164	.19	1,360	B.
November	683	19	199	1.47	1.64	11,800	A.
December	411	144	197	1.46	1.68	12,100	A.
The period	.....	.....	.....	.....	.....	82,300	

TOPPENISH CREEK NEAR WAPATO, WASH.

This station was established March 10, 1909, to replace a station 10 miles downstream from this point, formerly designated as Toppenish Creek near Toppenish. It is located about 5 miles south and 9 miles west of Wapato and 1,000 feet below the mouth of Simcoe

Creek. The data are of value in connection with the proposed project for the irrigation of lands in the Yakima Indian Reservation.

The gage is of the chain and weight type and is fastened to a cantilever beam on the left bank 200 feet above the cable from which measurements are made. The banks of the stream are comparatively high, but are subject to overflow at high stages. They are covered with a thick growth of willows and brush. The bed of the stream is of sand and is liable to change during medium and high stages.

Discharge measurements of Toppenish Creek near Wapato, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 10	L. R. Allen	23	90	4.53	146
May 4	H. D. McGlashan	32	239	9.20	400

Daily gage height, in feet, of Toppenish Creek near Wapato, Wash., for 1909.

[H. W. Heath, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		8.8	8.6			1.7	1.4	1.5	
2		9.8	8.6			1.7	1.4		
3			9.5			1.8	1.4		
4			9.8			1.8	1.4		
5			9.0			1.9	1.4		
6			8.4			1.7	1.4		
7		6.8	7.9			1.7	1.4		
8						1.7	1.4		
9			7.6	3.6		1.6	1.4		
10	4.5		7.0			1.6	1.4		
11	4.5		6.7			1.6	1.4		
12	4.6	7.7	6.7			1.5	1.4		
13	4.7		6.6			1.5	1.4		
14	5.0		6.5		2.0	1.5	1.4		
15	5.6	9.0	6.5		2.1	1.5	1.4		
16	6.2		6.4			1.5	1.4		
17	6.8					1.5	1.4		
18	7.2	8.2				1.5	1.4		
19	7.2					1.5	1.4		
20	6.8					1.5	1.4		
21	6.6					1.5	1.4		
22	6.1	7.6				1.5	1.4		
23	5.9		5.2			1.5	1.4		
24	5.9		5.0			1.5	1.4		
25	5.1		4.7			1.5	1.4		11.6
26	6.7		4.7			1.5	1.4		
27	7.3		4.5			1.5	1.4		
28					1.9	1.5	1.4		
29			4.4		1.8	1.5	1.5		
30	8.6	8.1	4.4		1.8	1.5	1.5		7.7
31	8.45		4.3		1.7	1.4			

NOTE.—River frozen over on Dec. 15.

Daily discharge, in second-feet, of Toppenish Creek near Wapato, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	374	363	.....	.....	34	26	28	.....
2	.....	433	363	.....	.....	34	26	.....	.....
3	.....	433	415	.....	.....	37	26	.....	.....
4	.....	433	433	.....	.....	37	26	.....	.....
5	.....	264	385	.....	.....	40	26	.....	.....
6	.....	264	352	.....	.....	34	26	.....	.....
7	.....	264	325	.....	.....	34	26	.....	.....
8	.....	264	316	.....	.....	34	26	.....	.....
9	.....	264	308	104	.....	31	26	.....	.....
10	147	314	275	.....	.....	31	26	.....	.....
11	147	314	259	.....	.....	31	26	.....	.....
12	152	314	259	.....	.....	28	26	.....	.....
13	157	314	253	.....	.....	28	26	.....	.....
14	171	385	248	.....	43	28	26	.....	.....
15	201	385	248	.....	46	28	26	.....	.....
16	231	385	242	.....	.....	28	26	.....	.....
17	264	341	242	.....	.....	28	26	.....	.....
18	286	341	242	.....	.....	28	26	.....	.....
19	286	332	242	.....	.....	28	26	.....	.....
20	264	324	181	.....	.....	28	26	.....	.....
21	253	316	181	.....	.....	28	26	.....	.....
22	226	308	181	.....	.....	28	26	.....	.....
23	216	308	181	.....	.....	28	26	.....	.....
24	216	308	171	.....	.....	28	26	.....	.....
25	176	308	157	.....	.....	28	26	.....	541
26	259	322	157	.....	.....	28	26	.....	.....
27	292	336	147	.....	.....	28	26	.....	.....
28	292	336	144	.....	40	28	26	.....	.....
29	363	336	142	.....	37	28	28	.....	.....
30	363	336	142	.....	37	28	28	.....	314
31	355	.....	137	.....	34	26	.....	.....	.....

NOTE.—These discharges are based on a rating curve that is fairly well defined above 120 second-feet.

Monthly discharge of Toppenish Creek near Wapato, Wash., for 1909.

[Drainage area, 416 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Mar. 10–31	363	147	242	0.582	0.48	10,600	B.
April	433	264	332	.798	.89	19,800	C.
May	433	137	248	.596	.69	15,200	C.
August	40	26	30.1	.072	.08	1,850	D.
September	28	26	26.1	.063	.07	1,550	D.

TOPPENISH CREEK NEAR TOPPENISH, WASH.

This station was established October 31, 1908, to aid the United States Reclamation Service in its general study of the water supply available for the development of the Wapato project and was abandoned March 3, 1909, in favor of Wapato station. It was located at Prahl's ranch, 4 miles south and 4 miles west of Toppenish. The chain gage was located on the right bank at the cable.

The conditions at this station, although not favorable for refined results, are such that the entire flow is measured except during

extreme high water, when a slough half a mile south of the station will probably carry some water.

The following discharge measurement was made by L. R. Allen:

March 4, 1909: Width, 29 feet; area, 137 square feet; gage height, 4.86 feet; discharge, 210 second-feet.

Daily gage height, in feet, of Toppenish Creek near Toppenish, Wash., for 1909.

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1	2.2	3.3	11	.....	3.5	21	6.1	6.0
2	2.2	3.5	12	.....	3.5	22	6.6	5.9
3	2.3	3.9	13	.....	3.5	23	7.0	5.9
4	2.5	4.3	14	.....	3.5	24	6.4	5.4
5	2.0	4.4	15	.....	3.5	25	5.5	5.0
6	.....	4.2	16	.....	3.7	26	4.75	5.2
7	.....	4.2	17	1.9	3.7	27	4.0	5.1
8	.....	4.1	18	2.2	4.3	28	3.5	5.0
9	.....	3.8	19	3.65	4.9	29	3.5	.....
10	.....	3.4	20	5.8	5.0	30	3.15	.....
						31	3.3	.....

NOTE.—Creek frozen over Jan. 6 to 17. Above gage height 5 feet creek overflows banks.

Daily discharge, in second-feet, of Toppenish Creek near Toppenish, Wash., for 1908 and 1909.

Day.	1908		1909		Day.	1908		1909		Day.	1908		1909	
	Nov.	Dec.	Jan.	Feb.		Nov.	Dec.	Jan.	Feb.		Nov.	Dec.	Jan.	Feb.
1	.....	82	71	118	11	64	78	40	128	21	74	45	.....	.....
2	.....	80	71	128	12	64	82	40	128	22	76	45	.....	.....
3	.....	76	74	149	13	64	74	40	128	23	78	48	.....	.....
4	.....	74	82	173	14	64	68	40	128	24	76	65	.....	.....
5	.....	72	65	179	15	65	65	40	128	25	74	103	.....	220
6	.....	72	40	167	16	66	50	40	138	26	71	118	202	.....
7	.....	74	40	167	17	68	50	62	138	27	70	118	155	.....
8	64	76	40	161	18	71	48	71	173	28	68	98	128	220
9	64	78	40	143	19	72	46	136	213	29	70	82	128	.....
10	66	78	40	123	20	74	46	.....	220	30	72	72	110	.....
										31	.....	71	118	.....

NOTE.—These discharges are based on a rating curve that is not well defined. Above gage height 5 feet the creek overflows its banks and no high-water measurements have been obtained to define the high-water portion of the curve.

TOPPENISH CREEK AT ALFALFA, WASH.

This station, which is located at the highway bridge 300 feet above the Northern Pacific Railway crossing, one-half mile east of Alfalfa, Wash., and a short distance above the mouth of the stream, was established March 6, 1909, to obtain data for use in a general study for the reclamation of lands in the Yakima Indian Reservation. The agricultural lands are very flat and an extensive drainage system must be constructed in connection with the proposed irrigation system.

The gage is a vertical staff on the right and downstream side of the bridge from which measurements are made. The banks of the stream are comparatively low and will overflow in extreme high water. The bed of the stream is rocky and subject to change during freshets.

Discharge measurements of Toppenish Creek at Alfalfa, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 6	L. R. Allen	43	120	1.93	362
May 3	H. D. McGlashan	46	124	2.14	408
July 13	H. Kimble	28	107	1.35	149
Sept. 28	do	26	100	.90	84

Daily gage height, in feet, of Toppenish Creek at Alfalfa, Wash., for 1909.

[Preston Meyers, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.39	2.3	1.8	1.4	1.4	1.1	0.8	1.1	2.4
2	.....	2.39	2.9	1.9	1.4	1.3	1.2	.8	1.1	2.7
3	.....	2.38	2.14	1.9	1.5	1.4	1.1	1.1	1.0	2.8
4	.....	2.36	2.1	1.9	1.4	1.5	1.1	1.3	1.2	2.7
5	.....	2.38	2.1	2.0	1.3	1.5	1.0	1.2	1.3	2.5
6	1.95	2.32	2.0	2.0	1.4	1.4	1.0	1.2	1.4	2.4
7	1.9	2.3	2.1	2.0	1.5	1.4	1.1	1.2	1.5	2.4
8	1.9	2.23	2.2	1.9	1.4	1.5	1.1	1.2	1.6	2.3
9	1.9	2.21	2.3	2.0	1.4	1.4	1.0	1.3	1.6	2.4
10	1.89	2.2	2.2	1.9	1.4	1.3	.9	1.3	1.5	2.3
11	1.84	2.1	2.1	1.8	1.3	1.3	1.1	1.2	1.5	2.2
12	1.85	2.15	2.1	1.9	1.3	1.3	1.2	1.2	1.6	2.3
13	1.81	2.15	2.1	1.8	1.3	1.4	1.1	1.3	1.5	2.2
14	1.81	2.14	2.0	1.8	1.4	1.4	1.1	1.2	1.5	2.1
15	1.82	2.15	2.0	1.8	1.3	1.4	.9	1.2	1.6	2.3
16	1.85	2.23	2.0	1.7	1.2	1.3	.9	1.1	1.6	2.2
17	1.89	2.29	2.0	1.8	1.2	1.2	.8	1.1	1.6	2.3
18	1.85	2.3	2.0	1.7	1.2	1.3	.8	1.3	1.7	2.2
19	1.89	2.2	1.9	1.7	1.2	1.2	.8	1.2	1.7	2.1
20	1.94	2.19	2.0	1.8	1.2	1.3	.8	1.2	1.7	2.1
21	2.0	2.15	2.0	1.8	1.3	1.3	.8	1.2	1.7	2.1
22	2.0	2.12	2.0	1.7	1.3	1.2	.9	1.2	1.8	2.0
23	2.07	2.1	1.9	1.7	1.2	1.3	.9	1.3	1.9	2.0
24	2.02	2.3	1.9	1.6	1.3	1.2	.8	1.3	2.1	2.0
25	2.0	2.09	1.8	1.6	1.3	1.3	.9	1.2	2.2	1.9
26	2.0	2.09	1.8	1.6	1.4	1.3	.8	1.1	2.8	1.8
27	1.95	2.1	1.8	1.5	1.4	1.3	.8	1.1	2.9	1.9
28	2.10	2.1	1.8	1.5	1.5	1.2	.9	1.1	2.7	1.9
29	2.24	2.25	1.8	1.5	1.4	1.2	.8	1.1	2.6	1.8
30	2.26	2.3	1.9	1.4	1.4	1.2	.8	1.2	2.4	1.8
31	2.30	.....	1.8	.....	1.4	1.1	.....	1.2	.....	1.7

NOTE.—No ice reported, but station is undoubtedly subject to ice influences.

Daily discharge, in second-feet, of Toppenish Creek at Alfalfa, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	536	496	296	173	173	110	77	110	540
2	.....	536	766	332	173	149	128	77	110	674
3	.....	531	427	332	200	173	110	110	95	720
4	.....	522	410	332	173	200	110	149	128	674
5	.....	531	410	370	149	200	95	128	149	584
6	351	505	370	370	173	173	95	128	173	540
7	332	496	410	370	200	149	110	128	200	540
8	332	465	452	332	173	173	110	128	230	496
9	332	456	496	370	173	200	95	149	230	540
10	328	452	452	332	173	149	84	149	200	496
11	310	410	410	296	149	149	110	128	200	452
12	314	431	410	332	149	149	128	128	230	496
13	300	431	410	296	149	173	110	149	200	452
14	300	427	370	296	173	173	110	128	200	410
15	303	431	370	296	149	173	84	128	230	496
16	314	465	370	262	128	149	84	110	230	452
17	328	492	370	296	128	128	77	110	230	496
18	314	496	370	262	128	149	77	149	262	410
19	328	452	332	262	128	128	77	128	262	452
20	347	448	370	296	128	149	77	128	262	410
21	370	431	370	296	149	149	77	128	262	410
22	370	418	370	262	149	128	84	128	296	370
23	398	410	332	262	128	149	84	149	332	370
24	378	410	332	230	149	128	77	149	410	370
25	370	406	296	230	149	149	84	128	452	332
26	370	406	296	230	173	149	77	110	720	296
27	351	410	296	200	173	149	77	110	766	332
28	410	410	296	200	200	128	84	110	674	332
29	470	474	296	200	173	128	77	110	628	296
30	478	496	332	173	173	128	77	128	540	296
31	496	.....	296	.....	173	110	.....	128	.....	262

NOTE.—These discharges are based on a fairly well defined rating curve.

Monthly discharge of Toppenish Creek at Alfalfa, Wash., for 1909.

[Drainage area, 520 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 6–31	496	300	357	0.687	0.66	18,400	A.
April	536	406	459	.883	.99	27,300	A.
May	766	296	387	.744	.86	23,800	A.
June	370	173	287	.552	.62	17,100	A.
July	200	128	160	.308	.36	9,840	A.
August	200	110	153	.294	.34	9,410	A.
September	128	77	92.6	.178	.20	5,510	A.
October	149	77	125	.240	.28	7,690	A.
November	766	95	300	.577	.64	17,900	A.
December	720	262	451	.867	1.00	27,700	A.
The period	.....	.....	.....	.....	.....	165,000	

SIMCOE CREEK NEAR FORT SIMCOE, WASH.

This station, which is located 3 miles north and 2 miles east of Fort Simcoe, Wash., in sec. 34, T. 11 N., R. 16 E., at the site for a proposed dam where considerable storage can be developed, was established February 28, 1909, to obtain data for use in connection with the irrigation of lands in Yakima Indian Reservation.

The gage is of the chain-and-weight type and is fastened to a cantilever beam 10 feet above the gage on the right bank. The length of the chain is 11.50 feet. Measurements are made from a foot log. The banks of the stream are low and liable to overflow during high water. The bed of the stream is gravel and sand and liable to change during freshets.

Discharge measurements of Simcoe Creek near Fort Simcoe, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 28..	Allen and Hews	22	30	2.10	55
28.	.....do	22	29	2.10	55
Mar. 11..	A. Hews	22	26.2	1.96	45.6
19..	Hews and Merrill	22	33.2	2.35	74.7
May 25..	H. D. McGlashan	22.5	25	1.86	42
July 16 [a]	H. Kimble	6.2	3.7	1.15	1.8

[a] Made by wading, but not at regular station.

Daily gage height, in feet, of Simcoe Creek near Fort Simcoe, Wash., for 1909.

[Parchese Wolloock, observer.]

Day.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.0	2.5	2.3	1.7	1.2	1.0	1.0	0.9	1.1	2.4
2	.....	2.0	2.5	2.4	1.7	1.2	1.0	1.0	.9	1.2	2.3
3	.....	2.0	2.4	2.5	1.7	1.2	1.0	1.0	.9	.....	2.2
4	.....	2.1	2.3	2.6	1.7	1.2	1.0	1.0	.9	.....	2.1
5	.....	2.0	2.3	2.4	1.6	1.2	1.0	1.0	.9	.....	2.1
6	.....	2.0	2.2	2.4	1.6	1.2	1.0	1.0	.9	.....	2.0
7	.....	1.9	2.1	2.4	1.6	1.2	1.0	1.0	.9	1.2	2.0
8	.....	1.9	2.0	2.4	1.5	1.2	1.0	1.0	.9	1.2	1.9
9	.....	1.9	2.0	2.3	1.5	1.2	1.0	1.0	.9	1.2	1.8
10	.....	1.9	2.1	2.3	1.5	1.2	1.0	1.0	.9	1.2	1.7
11	.....	1.8	2.1	2.2	1.4	1.2	1.0	1.0	1.1	1.2	1.7
12	.....	1.9	2.1	2.2	1.4	1.2	1.0	1.0	1.1	1.2	1.7
13	.....	2.0	2.3	2.1	1.4	1.2	1.0	.9	1.1	1.2	1.7
14	.....	.....	2.3	2.1	1.4	1.1	1.0	.9	1.1	1.2	1.7
15	.....	2.3	2.3	2.1	1.4	1.1	1.0	.9	1.1	1.2	1.7
16	.....	2.4	2.3	2.1	1.4	1.1	1.0	.9	1.1	1.2	1.7
17	.....	2.4	2.2	2.1	1.4	1.1	1.0	.9	1.1	1.2	1.7
18	.....	2.4	2.2	2.1	1.3	1.1	1.0	.9	1.1	1.2	1.7
19	.....	2.4	2.1	2.0	1.3	1.1	1.0	.9	1.1	1.2	1.7
20	.....	2.3	2.1	2.0	1.3	1.1	1.0	.9	1.1	1.2	1.7
21	.....	2.2	2.1	2.0	1.3	1.1	1.0	.9	1.1	1.2	1.7
22	.....	2.2	2.1	2.0	1.3	1.1	1.0	.9	1.1	1.2	1.7
23	.....	2.1	2.1	2.0	1.3	1.1	1.0	.9	1.1	1.3	1.7
24	.....	2.1	2.1	1.9	1.3	1.1	1.0	.9	1.1	2.3	.....
25	.....	2.2	2.1	1.9	1.3	1.1	1.0	.9	1.1	2.4	.....
26	.....	2.3	2.1	1.9	1.3	1.1	1.0	.9	1.1	2.5	1.7
27	.....	2.4	2.2	1.9	1.2	1.1	1.0	.9	1.1	2.5	1.7
28	2.1	2.5	2.3	1.9	1.2	1.0	1.0	.9	1.1	.....	1.7
29	.....	2.6	2.3	1.9	1.2	1.0	1.0	.9	1.1	2.5	1.7
30	.....	2.5	2.2	1.9	1.2	1.0	1.0	.9	1.1	2.5	1.7
31	.....	2.5	.....	1.8	.....	1.0	1.0	.....	1.1	.....	1.7

Daily discharge, in second-feet, of Simcoe Creek near Fort Simcoe, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	49	87	71	28	3	0.1	0.1	0.0	0.7	79
2	49	87	79	28	3	.1	.1	.0	3	71
3	49	79	87	28	3	.1	.1	.0	3	63
4	56	71	95	28	3	.1	.1	.0	3	56
5	49	71	79	22	3	.1	.1	.0	3	56
6	49	63	79	22	3	.1	.1	.0	3	49
7	42	56	79	22	3	.1	.1	.0	3	49
8	42	49	79	16	3	.1	.1	.0	3	42
9	42	49	71	16	3	.1	.1	.0	3	35
10	42	56	71	16	3	.1	.1	.0	3	28
11	35	56	63	11	3	.1	.1	.7	3	28
12	42	56	63	11	3	.1	.1	.7	3	28
13	49	71	56	11	3	.1	.0	.7	3	28
14	60	71	56	11	.7	.1	.0	.7	3	28
15	71	71	56	11	.7	.1	.0	.7	3	28
16	79	71	56	11	.7	.1	.0	.7	3	28
17	79	63	56	11	.7	.1	.0	.7	3	28
18	79	63	56	7	.7	.1	.0	.7	3	28
19	79	56	49	7	.7	.1	.0	.7	3	28
20	71	56	49	7	.7	.1	.0	.7	3	28
21	63	56	49	7	.7	.1	.0	.7	3	28
22	63	56	49	7	.7	.1	.0	.7	3	28
23	56	56	49	7	.7	.1	.0	.7	7	28
24	56	56	42	7	.7	.1	.0	.7	71	28
25	63	56	42	7	.7	.1	.0	.7	79	28
26	71	56	42	7	.7	.1	.0	.7	87	28
27	79	63	42	3	.7	.1	.0	.7	87	28
28	87	71	42	3	.1	.1	.0	.7	87	28
29	95	71	42	3	.1	.1	.0	.7	87	28
30	87	63	42	3	.1	.1	.0	.7	87	28
31	87	.....	35	.....	.1	.1	.....	.7	.....	28

NOTE.—These discharges are based on a well-defined rating curve. Discharges interpolated for days having no gage record.

Monthly discharge of Simcoe Creek near Fort Simcoe, Wash., for 1909.

[Drainage area, 80 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	95	35	61.9	0.774	0.89	3,810	A.
April	87	49	63.5	.794	.89	3,780	A.
May	95	35	58.9	.736	.85	3,620	A.
June	28	3	12.6	.158	.18	750	C.
July	3	.1	1.59	.020	.02	98	C.
August	.1	.1	.1	.0012	.001	6	D.
September	.1	.0	.04	.0005	.0006	2	D.
October	.7	.0	.47	.0059	.007	29	D.
November	87	.7	21.9	.274	.31	1,300	C.
December	79	28	36.0	.450	.52	2,210	B.
The period	.....	.....	.....	.....	.....	15,600	.....

SATAS CREEK NEAR TOPPENISH, WASH.

Satas Creek drains the southern part of the Yakima Indian Reservation and unites with Yakima River about 8 miles below the mouth of Toppenish Creek. The drainage area of Satas Creek at its mouth is about 600 square miles.

This station, which is located a short distance above the mouth of Dry Creek, about 1,000 feet below the public highway and ford, 4 miles west and 10 miles south of Toppenish, Wash., was established November 8, 1908, to obtain data for use by the United States Reclamation Service in connection with the development of the Wapato project.

The gage is a vertical staff in two sections, located about 150 feet above the measuring section. Discharge measurements are made from a cable equipment. The gage is a short distance above a riffle control, and a stable relation between gage heights and discharge can probably be determined. Owing, however, to its isolated location, only weekly readings have been obtained.

Discharge measurements of Satas Creek near Toppenish, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Dis-charge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 17	L. R. Allen	65	137	2.65	538
May 6	H. D. McGlashan	57	72	1.58	161
July 12	H. Kimble	40	40	.90	40
Sept. 27	do	36	30	.60	15

Daily gage height, in feet, of Satas Creek near Toppenish, Wash., for 1909.

[Hall L. Jenson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1								0.8				
2												
3	1.0						0.9			0.7		
4				1.7								
5									0.6			1.8
6					1.58	1.5						
7		1.25	1.6								0.9	
8								.7				
9												
10	1.4									.75		
11				1.55			.9					
12							.9		.6			1.9
13						1.4						
14			1.5								.95	
15								.65				
16		2.2			1.55							
17	1.9	2.65								.75		
18				1.6			.85		.6			
19												1.8
20			1.6			1.3						
21		1.8									1.75	
22	[a] 9.0							.7				
23					1.5							
24	1.9									.85		
25				1.6			.8					
26									.7			1.7
27						1.1			.6			
28		1.7	1.7								2.1	
29								.65				
30					1.5							
31	1.5									.9		

[a] Gage height determined from high-water marks.

Daily discharge, in second-feet, of Satas Creek near Toppenish, Wash., for 1908 and 1909.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	32	11	32	32	21	39	41
2	.....	32	12	32	32	22	41	41
3	.....	32	13	32	32	23	40	41
4	.....	32	14	32	33	24	38	41
5	.....	32	15	32	35	25	37	41
6	28	32	16	33	36	26	36	41
7	30	32	17	34	37	27	35	41
8	32	32	18	34	38	28	33	41
9	32	32	19	35	40	29	32	41
10	32	32	20	37	41	30	32	41
						31	.....	41

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	41	119	166	190	166	142	52	30	15	22	40	312
2	41	119	166	190	166	142	40	30	15	22	46	278
3	41	100	166	190	166	142	40	30	15	22	52	262
4	48	100	166	190	166	142	40	30	15	22	52	246
5	53	82	166	190	166	142	40	22	15	22	52	216
6	67	82	166	166	161	142	40	22	15	22	46	216
7	67	74	166	142	166	142	40	22	15	26	40	216
8	82	67	166	142	166	142	40	22	15	26	40	231
9	82	67	166	166	190	142	40	22	15	26	40	231
10	100	67	166	166	190	142	40	22	15	26	40	246
11	119	67	166	154	166	142	40	22	15	26	40	246
12	119	67	142	166	166	120	40	22	15	26	40	246
13	140	67	142	166	166	120	40	15	15	26	46	246
14	163	67	142	190	166	120	40	15	15	26	46	246
15	189	163	166	190	166	120	40	18	15	26	52	231
16	218	325	190	166	154	120	40	15	15	26	59	231
17	218	538	190	166	142	100	40	15	15	26	100	216
18	163	426	166	166	142	100	35	22	15	26	120	216
19	119	348	166	166	142	100	30	22	15	26	142	216
20	82	278	166	166	142	100	30	22	15	30	166	216
21	52	216	166	166	142	100	30	22	15	30	203	203
22	*a* 500	216	166	166	142	100	30	22	15	35	231	203
23	218	216	142	166	142	82	30	22	22	35	262	203
24	218	216	142	166	142	82	30	22	22	35	348	190
25	189	190	166	166	142	82	30	22	22	35	386	190
26	189	190	166	166	142	66	30	22	22	35	386	190
27	189	190	190	166	142	66	30	22	15	35	348	190
28	163	190	190	166	142	66	30	22	22	40	312	190
29	140	.....	190	166	142	52	30	18	22	40	330	190
30	140	.....	190	166	142	52	30	22	22	40	330	190
31	119	.....	190	.....	142	.....	30	22	.....	40	.....	190

a The high water of Jan. 22, 1909, may have been caused by a temporary ice jam below the station combined with some flood water. Discharge estimated for this day.

NOTE.—The daily discharges for 1908 and 1909 are based on rating curves applicable as follows: Nov. 6, 1908, to Feb. 17, 1909, fairly well defined above 40 second-feet; Feb. 18 to Dec. 31, 1909, well defined; the daily discharges for 1908 and 1909 have been obtained from these rating curves by interpolation between observer's gage heights and by means of a hydrographic comparison with Toppenish Creek near Fort Simcoe.

Monthly discharge of Satas Creek near Toppenish, Wash., for 1908–9.

[Drainage area, 246 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
1908.						
Nov. 6-30	41	28	34.0	0.138	0.13	1,690
December	41	32	36.4	.148	.17	2,240
1909.						
January	[a] 500	41	138	.561	.65	8,480
February	538	67	173	.703	.73	9,610
March	190	142	168	.683	.79	10,300
April	190	142	170	.691	.77	10,100
May	190	142	155	.630	.73	9,530
June	142	52	110	.447	.50	6,550
July	52	30	36.0	.146	.17	2,210
August	30	15	21.9	.089	.10	1,350
September	22	15	16.6	.067	.07	988
October	40	22	29.0	.118	.14	1,780
November	386	40	146	.593	.66	8,690
December	312	190	222	.902	1.04	13,600
The year	538	15	115	.469	6.35	83,200

[a] Estimated.

NOTE.—These estimates are based on daily discharges obtained largely by interpolation and a hydrographic comparison with Toppenish Creek near Fort Simcoe and are considered as conservative.

CANALS IN YAKIMA VALLEY.

DESCRIPTION.

About 50 private irrigation canals divert water from Yakima River and its tributaries. These, together with existing Government canals, irrigate approximately 200,000 acres of land and use more than the entire natural flow of Yakima River at low water.

In order to obtain an ample supply during the period of extreme low water, temporary storage dams have been constructed at the outlets of the three Yakima lakes—Keechelus, Kachess, and Clealum. The temporary reservoirs thus formed impound about 80,000 acre-feet of the flood-water flow of the river, and this, when drawn out as needed during the irrigating season, furnishes enough water to supply all the land under existing projects.

Only about one-half of the total irrigable area in the Yakima Valley, however, is now under irrigation ditches. Extensive projects are under way or prospective, by which the United States Reclamation Service proposes to more than double the present irrigated area of the Yakima Valley. To do this the low-water flow of Yakima River must be increased to more than double its present amount, and five large storage dams will be constructed for this purpose. Each of the temporary dams at the three Yakima lakes will be replaced by an immense permanent dam; the large storage dam at Bumping Lake, now nearing completion, and a proposed dam at McAllister Meadows, on Tieton River, will also be operated. The

combined capacity of the reservoirs formed by these five large dams will aggregate about 800,000 acre-feet. This water, if economically distributed, will water practically all the irrigable area in the Yakima Valley.

These general statements as to the magnitude of the Yakima projects make at once apparent the great importance of hydrographic work in this valley. It is obvious that a systematic study of canal discharge must be maintained here in order to apportion the stored water equitably among users, to procure data which will lead to an economical irrigation duty, and to promote sound engineering in the construction of future systems and units of this system.

The first hydrographic work on private canals in the Yakima Valley was done in 1904. During that year an estimate of discharge was obtained on all the larger canals.[1] This work was continued in 1905, and a diversion duty was settled upon, the rights of private users estimated, and acreage under private projects determined.[2] After 1905 the private canal work was practically dropped, although a few miscellaneous measurements were made in 1906. Nothing at all was done in 1907 and 1908.

Owing to large increases in acreage under private and Government canals in the years following 1905, it was found that the records of acreage, duty, and discharge obtained at that time were fast becoming out of date, and that it would be desirable to obtain a continuous record of private canal discharge in order to handle stored waters effectively and apportion the supply equitably among users.

To this end the private canal work was again taken up in 1909. A record of flow was secured on the principal ditches for three months—July, August, and September. This work in 1909 was under the supervision of C. F. Gleason, junior engineer of the United States Reclamation Service.

Canals diverting water from Yakima River.

Canal.	Nearest town.	Headworks.			Bank of river.	Length (miles).
		Section.	Township.	Range.		
KITTITAS VALLEY.						
Cascade	Thorp		19 N.	17 E.	Left	42½
West Kittitas	do	33	19 N.	17 E.	Right	14
Ellensburg Water Co.	Ellensburg	7	18 N.	17 E.	Left	30
Olsen	do	18	18 N.	18 E.	Left	
Bull	do				Left	
Fogarty	do				Right	
YAKIMA-MOXEE VALLEYS.						
Selah-Moxee	Selah	8	14 N.	19 E.	Left	27
Taylor	do				Right	4½
Moxee Co. (includes Moxee and Hubbard canals).	North Yakima	7	13 N.	19 E.	Left	8
Fowler	do	18	13 N.	19 E.	Left	8½
Granger	do	18	13 N.	19 E.	Left	

[1] See Water-Supply Paper U. S. Geol. Survey No. 135.
[2] See Water-Supply Paper U. S. Geol. Survey No. 178.

Canals diverting water from Yakima River—Continued.

Canal.	Nearest town.	Headworks.			Bank of river.	Length (miles).
		Section.	Township.	Range.		
INDIAN RESERVATION BASIN.						
New Reservation	Yakima	17	12 N.	19 E.	Right	
Old Reservation	Wapato	28	12 N.	19 E.	Right	
Sunnyside	do	28	12 N.	19 E.	Left	
Gilbert	do				Right	
Hatch	do				Right	
LOWER YAKIMA CANALS.						
Prosser Falls	Prosser				Right	
Ledbetter	do				Right	
Benton Water Co	Kiona				Left	
Kiona	do	10	9 N.	26 E.	Left	9
Kiona Water Supply Co	do				Left	
Kennewick	Kennewick	3	10 N.	27 E.	Right	
Lower Yakima (formerly Grosscup)	Kiona	3	10 N.	27 E.	Left	
Amon	do				Left	

Canals diverting water from Naches River.

Canal.	Nearest town.	Headworks.			Bank of river.	Length (miles).
		Section.	Township.	Range.		
ABOVE TIETON RIVER.						
Small ditches	Naches					
Selah Valley	do	35	15 N.	16 E.	Left	20
BETWEEN TIETON RIVER AND COWICHE CREEK.						
Wapatox	Naches	36	15 N.	16 E.	Left	16
John Cox	do	6	14 N.	17 E.	Right	
Clark	do		14 N.	17 E.	Left	
Upper Scott	do	4	14 N.	17 E.	Right	
Lowery	do		14 N.	17 E.	Left	
Kelly	do		14 N.	17 E.	Left	
Fortune	do	9	14 N.	17 E.	Right	
Lower Scott	do	9	14 N.	17 E.	Right	
Basket Ford	do				Right	
Gleed	do	24	14 N.	17 E.	Left	6
Morrisey	do	25	14 N.	17 E.	Left	
Congdon or Yakima Valley	do	24	14 N.	17 E.	Right	22
White & Leach	do				Left	
McCormick & Long	do				Left	
Chapman & Nelson	do				Left	
Schuler & Rodenback	North Yakima				Right	
Naches-Cowiche	do	9	13 N.	18 E.	Right	7
BELOW COWICHE CREEK.						
Power Canal	North Yakima	10	13 N.	18 E.	Right	6
Fruitvale Schawno		10	13 N.	18 E.		
R. S. and C						
Shanno		11	13 N.	18 E.		8
Broadgage		10	13 N.	18 E.		3
Union	North Yakima	11	13 N.	18 E.	Right	8½
North Yakima Town	do	12	13 N.	18 E.	Right	

NEW RESERVATION CANAL NEAR YAKIMA, WASH.

The New Reservation canal diverts water from the right bank of Yakima River 6 miles below North Yakima and just below Union Gap.

The gaging station was established May 9, 1904, at a highway bridge 1,000 feet belwo the head gate and above all diversions from

the canal. The canal carries a small amount of water during the winter months for domestic uses, but the station records are of value only in connection with irrigation.

At present the canal is owned and operated by the United States Indian Service. The Wapato project of the United States Reclamation Service, by which the lands on the Yakima Indian Reservation will be irrigated, involves as one of its features the enlargement and extension of the canal.

The conditions at the station are not favorable for good results. The current in the canal is low, and water grass grows profusely in the bed and on the banks of the canal, creating backwater at the gage as the season advances. Several unsuccessful attempts have been made to get rid of this growth, as it interferes with the operation of the canal. Discharges therefore must be obtained by the indirect method, which will give reasonably accurate results if a sufficient number of measurements are secured.

Discharge measurements of New Reservation canal near Yakima, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	H. D. McGlashan	38	120	2.88	257
31	do	38	130	3.24	300
June 14	do	38	105	2.57	195
July 8	Gleason and Ray	38	143	3.50	285
14	Kimble and Gleason	38	140	3.50	297
31	T. A. Noble	38	144	3.79	249
Aug. 3	Richie Ray	38	147	3.57	213
27	T. A. Noble	38	131	3.25	146
Sept. 4	C. F. Gleason	38	121	3.00	122

Daily gage height, in feet, of New Reservation canal near Yakima, Wash., for 1909.

[F. H. Hall, observer.]

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	1.1	3.1	3.2	3.7	3.6	3.3	2.8	2.0
2	1.1	3.1	3.3	3.8	3.6	3.0	2.8	2.0
3	1.2	3.0	3.1	3.8	3.6	3.0	3.0	2.0
4	1.2	2.9	3.0	3.7	3.6	3.0	3.0	2.0
5	1.3	2.9	3.0	3.7	3.5	3.0	3.0	2.0
6	1.3	2.8	2.7	3.6	3.5	3.0	2.9	2.0
7	1.7	2.8	2.7	3.6	3.5	3.0	2.9	1.8
8	1.7	2.9	2.8	3.6	3.5	3.0	2.9	1.8
9	1.9	3.0	2.8	3.5	3.6	3.0	2.9	1.8
10	2.3	3.0	2.8	3.5	3.7	3.0	2.8	1.8
11	2.1	2.9	2.9	3.5	3.8	3.0	2.8	1.8
12	2.4	2.9	2.7	3.6	3.8	3.0	2.8	1.8
13	2.5	2.8	2.6	3.7	3.8	3.0	2.8	1.8
14	2.5	2.9	2.6	3.5	3.9	3.0	2.8	1.8
15	2.7	3.1	2.6	3.5	3.9	3.0	2.8	1.8
16	2.8	2.9	2.6	3.7	3.3	3.0	2.8	1.7
17	2.9	2.9	2.5	3.8	3.3	3.0	2.5	1.8
18	2.9	3.3	2.5	3.7	3.3	3.0	2.5	1.8
19	2.9	3.3	2.5	3.6	3.3	3.0	2.5	1.8
20	2.9	3.3	2.5	3.6	3.3	3.0	2.5	1.8

Daily gage height, in feet, of New Reservation canal near Yakima, Wash., for 1909—Continued.

Day.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
21	3.0	3.2	2.5	3.7	3.3	3.0	2.5	1.6
22	3.0	3.2	2.8	3.7	3.3	3.0	2.5	1.6
23	3.0	3.1	2.8	3.7	3.3	3.0	2.5	1.6
24	3.1	3.2	3.1	3.7	3.3	3.0	2.4	1.6
25	3.1	3.3	3.2	3.7	3.3	3.0	2.4	1.6
26	3.0	3.4	3.3	3.7	3.3	3.0	2.4	1.4
27	3.0	3.4	3.4	3.8	3.3	3.0	2.4	1.4
29	2.9	3.3	3.4	3.8	3.3	3.0	2.3	1.4
29	2.9	3.3	3.5	3.7	3.3	3.0	2.3	1.4
30	2.9	3.2	3.6	3.6	3.3	2.8	2.1	1.4
31	.....	3.2	.....	3.6	3.3	.....	1.3	.....

Daily discharge, in second-feet, of New Reservation canal near Yakima, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	75	286	286	328	218	154	166	16	258	258	192	300	165	120	179
2	75	268	300	342	218	120	166	17	272	258	179	314	154	131	142
3	75	272	272	342	218	120	192	18	272	314	179	286	154	131	142
4	75	258	258	328	218	120	205	19	272	314	179	272	154	142	142
5	91	258	258	328	205	120	205	20	272	314	179	272	154	142	142
6	83	244	244	314	205	120	192	21	272	300	179	272	154	154	142
7	120	244	244	314	205	120	192	22	272	300	218	272	154	154	142
8	120	258	231	314	192	120	192	23	272	286	218	272	154	166	142
9	142	272	231	300	205	120	192	24	286	300	258	272	154	166	131
10	192	272	231	286	218	120	179	25	286	314	272	258	154	166	131
11	166	258	244	286	231	120	179	26	272	328	286	258	154	179	131
12	205	258	218	300	231	120	179	27	272	328	300	258	154	179	131
13	218	244	205	314	231	120	179	28	258	314	300	258	154	179	131
14	218	258	205	286	244	120	179	29	258	314	314	244	154	192	120
15	244	286	205	272	244	120	179	30	258	300	328	231	154	166	100
								31	.....	300	.....	231	154	.....	100

NOTE.—These discharges were obtained by the indirect method for shifting channels, on account of the effect of weeds.

Monthly discharge of New Reservation canal near Yakima, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	286	75	205	12,200	B.
May	328	244	284	17,500	B.
June	328	179	240	14,300	B.
July	342	231	288	17,700	B.
August	244	154	186	11,400	B.
September	192	120	140	8,330	B.
October	205	100	159	9,780	B.
The period	.....	.....	.....	91,200	

OLD RESERVATION CANAL NEAR WAPATO, WASH.

This canal was constructed and is operated by the United States Indian Service for the benefit of Indian lands on the Yakima Reservation.

A station was first established June 7, 1904, at the Northern Pacific Railway bridge about 1 mile below the head gate. A slough that carries considerable water is taken into this canal at a point 280 feet below the head gate. The water is carried to a point about 1,000 feet farther down the canal and there returned to the slough, which continues parallel to the river and forms both a wasteway for the canal and a channel from which diversions are made for irrigation.

On June 23, 1908, a new station was established 300 feet below the head gate of the canal and below the point where the waters from the slough are received, and just above the first diversion. The records at this point are not comparable with those formerly obtained at the railroad bridge, but they represent the amount of water taken from Yakima River.

Discharge measurements of Old Reservation canal near Wapato, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 5	H. D. McGlashan	19	89	3.50	240
31	do	20	100	3.96	292
June 14	do	18	72	2.70	176
July 8	Gleason and Ray	17.3	86	3.70	262
14	Kimble and Gleason	19	83	3.26	228
Aug. 14	T. A. Noble			1.80	129
20	do			1.05	78.7
20	do			3.25	159
27	do			1.05	77.4
Sept. 7	do			.63	53.5

Daily gage height, in feet, of Old Reservation canal near Wapato, Wash., for 1909.

[L. D. Stackhouse, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1		4.08	3.66		0.60		16		2.70				1.20
2		4.00			.62	1.20	17			2.92	1.90	0.70	
3		3.86	3.64		.62		18		2.60				
4				2.10	.66		19		2.52	2.74	1.08		
5	3.50	3.72	3.64				20			2.66	1.05		
6			3.80		.60		21			2.50	1.05		1.10
7		3.41	3.80	1.84			22		2.50				
8		3.02	3.72				23		3.42			.80	1.40
9		3.10	3.60	1.80			24		3.40	2.42	1.05		
10		2.70	3.52		.60		25		3.52	2.40		1.16	
11		2.74					26		3.54				
12		2.78	3.43				27			2.40	1.05		1.40
13			3.42				28		3.60	2.28	1.04		
14		2.70	3.28	1.80			29						
15						1.20	30		3.38	2.26		1.20	1.66
							31	3.96					

Daily discharge, in second-feet, of Old Reservation canal near Wapato, Wash., for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Day.	June.	July.	Aug.	Sept.	Oct.
1	290	257	151	50	86	16	186	210	128	55	86
2	284	256	148	51	86	17	182	201	130	56	85
3	273	255	146	51	86	18	179	195	104	57	84
4	268	255	144	54	86	19	173	189	79	58	83
5	262	255	138	52	86	20	173	183	77	59	82
6	250	268	132	50	86	21	172	172	77	60	80
7	237	268	126	52	86	22	172	170	77	61	89
8	208	262	124	51	86	23	238	168	77	62	98
9	214	252	123	51	86	24	236	166	77	73	98
10	186	246	123	50	86	25	246	165	77	84	98
11	189	242	123	51	86	26	247	165	77	84	98
12	192	238	123	52	86	27	250	165	77	85	98
13	189	238	123	53	86	28	252	157	76	85	103
14	186	227	123	53	86	29	243	156	70	86	108
15	186	218	126	54	86	30	234	155	63	86	114
						31	.....	153	56	.....	114

NOTE.—These discharges are based on a well-defined rating curve. Discharges for days having no gage record are interpolated.

Monthly discharge of Old Reservation canal near Wapato, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	290	172	220	13,100	B.
July	268	153	210	12,900	B.
August	151	56	106	6,520	B.
September	86	50	60.9	3,620	B.
October	114	80	90.6	5,570	B.
The period	.....	.....	.....	41,700	

SUNNYSIDE CANAL.

DESCRIPTION.[1]

The Sunnyside canal diverts water from the left bank of Yakima River in sec. 28, T. 12 N., R. 19 E., Willamette meridian. The canal system was purchased from the Washington Irrigation Co. by the United States Reclamation Service in July, 1906. Active operation by the Government began in 1907.

The canal is now 60 miles long and parallels Yakima River in its general direction. It irrigates practically all the land between the canal and the river, and has one lateral—Mabton siphon—which crosses the river to lands on the south side. In all, about 47,000 acres of land were irrigated in 1909. The operation of this system requires that hydrographic work of an exceptional degree of accuracy be carried on. During the irrigating season the general scheme of operation is effected by dividing the canal and the main lateral into

[1] Description abstracted in part from Stevens, J. C., Hydrography as an aid in the successful operation of an irrigation system; Proc. Am. Soc. Civil Eng., vol. 36, No. 9, November, 1910, p. 1320; also discussion in vol. 36, No. 10, December, 1910, p. 1737. Mr. Stevens's paper contains a detailed account of this canal, together with data as to the amount of water used at various points, and gains and losses from seepage.

beats, ranging in length from 3 to 8 miles, each in charge of a patrolman. Gaging stations, where the daily flow is measured, are maintained at the extremities of the beats. The amount diverted from the main canal is also measured by means of weirs or special measuring boxes. A complete discussion of the very interesting data that have been obtained on this canal system is too lengthy for discussion in this report, so that only the quantity of water diverted from Yakima River as measured at the intake is presented in detail.

SUNNYSIDE CANAL NEAR WAPATO, WASH.

This station was established April 22, 1904, although records of flow of the canal have been kept ever since it has been in operation. It is located 1,000 feet below the intake and above all deliveries.

A new inclined gage was installed April 6, 1907, but the published gage heights for 1907 refer to the old vertical staff gage used in 1906. On July 31, 1907, a gaging bridge was erected 600 feet below the intake of the canal. In the spring of 1908 a new inclined staff gage was set just above this bridge at a different datum. Gage heights for 1908 and 1909 are referred to this gage. Gage heights from April 20 to October 2, 1909 were taken by a Leitz self-registering gage set at the same datum as the staff gage at the bridge.

Discharge measurements of Sunnyside canal near Wapato, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 26	Stevens and Allen	43	134	3.04	333
26	do	43	134	3.04	323
Apr. 1	L. R. Allen	44.5	151	3.38	388
14	do	45.5	180	4.03	482
20	do	45.5	200	4.50	592
May 4	do	46	200	4.51	589
12	do	46	206	4.69	621
26	do	46	208	4.72	630
June 18	do	46	208	4.70	614
25	do	47	212	4.78	623
25	C. W. Harris	47	212	4.78	632
July 13	L. R. Allen	48	222	4.99	651
14	C. F. Gleason	46	220	4.97	685
16	L. R. Allen	48	222	5.00	658
23	do	48	227	5.10	677
31	do	48	227	5.10	690
Aug. 10	do	48	227	5.09	677
23	do	48	232	5.20	689
Sept. 6	do	46	212	4.82	625
24	do	46	204	4.60	581

Daily gage heights, in feet, of Sunnyside canal at headworks near Wapato, Wash., for 1909.

[W. R. Newland, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1....	3.40	4.50	4.70	4.91	5.10	4.90	4.65	16....	4.50	4.70	4.71	5.00	5.21	4.57	4.44
2....	3.50	4.50	4.71	4.91	5.10	4.89	4.65	17....	4.50	4.70	4.70	4.99	5.22	4.55	4.44
3....	3.50	4.48	4.71	4.97	5.08	4.83	4.48	18....	4.50	4.71	4.69	5.05	5.20	4.54	4.44
4....	3.65	4.47	4.70	5.01	5.10	4.80	4.47	19....	4.50	4.71	4.71	5.08	5.21	4.45	4.44
5....	3.80	4.46	4.70	5.00	5.10	4.80	4.47	20....	4.50	4.70	4.71	5.10	5.20	4.39	4.44
6....	3.90	4.46	4.70	5.00	5.09	4.80	4.47	21....	4.50	4.70	4.71	5.10	5.20	4.38	4.44
7....	4.00	4.61	4.70	5.00	5.09	4.80	4.47	22....	4.51	4.70	4.70	5.10	5.21	4.78	4.43
8....	4.00	4.66	4.70	4.99	5.10	4.80	4.47	23....	4.51	4.69	4.69	5.11	5.21	4.60	4.45
9....	4.10	4.70	4.71	5.00	5.11	4.71	4.47	24....	4.51	4.72	4.78	5.10	5.20	4.60	4.44
10....	4.10	4.71	4.71	5.00	5.11	4.79	4.48	25....	4.50	4.70	4.79	5.09	5.20	4.61	4.47
11....	4.10	4.69	4.70	5.01	5.00	4.79	4.43	26....	4.50	4.71	4.80	5.08	5.21	4.61	4.44
12....	4.10	4.69	4.70	4.88	5.16	4.78	4.43	27....	4.50	4.70	4.81	5.10	5.11	4.62	4.41
13....	4.00	4.70	4.70	5.00	5.09	4.76	4.43	28....	4.50	4.69	4.88	5.10	5.01	4.65	4.38
14....	4.00	4.70	4.70	4.99	5.20	4.71	4.45	29....	4.51	4.69	4.89	5.11	4.98	4.65	4.48
15....	4.20	4.70	4.70	4.99	5.19	4.56	4.45	30....	4.51	4.69	4.90	5.10	4.99	4.64	4.48
								31....	.....	4.70	.....	5.10	4.97	.....	4.48

NOTE.—Automatic gage from April 20 to October 2.

Daily discharge, in second-feet, of Sunnyside canal near Wapato, Wash., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1....	380	578	619	644	678	636	598	16....	578	619	619	657	701	592	548
2....	396	578	621	642	678	634	598	17....	578	619	617	655	703	588	548
3....	396	574	621	655	674	621	558	18....	578	621	615	667	699	586	548
4....	420	572	619	661	678	615	558	19....	578	621	617	674	701	568	548
5....	446	570	619	659	678	615	558	20....	578	619	615	678	699	556	548
6....	464	570	608	659	676	615	558	21....	578	619	615	678	699	554	548
7....	482	600	608	659	676	615	558	22....	580	619	611	678	701	634	548
8....	482	611	619	655	678	615	558	23....	580	617	606	680	701	598	548
9....	500	619	621	657	680	621	558	24....	580	623	623	678	699	598	548
10....	500	621	621	657	680	613	558	25....	578	619	623	676	699	598	548
11....	500	617	619	659	678	613	548	26....	578	621	625	674	701	598	548
12....	500	617	619	657	690	611	548	27....	578	619	625	678	680	598	548
13....	482	619	619	657	701	606	548	28....	578	617	640	678	659	598	548
14....	482	619	619	655	699	621	548	29....	580	617	640	680	653	598	548
15....	518	619	619	655	697	590	548	30....	580	617	642	678	655	598	548
								31....	.....	619	.....	678	650	.....	548

NOTE.—These discharges were obtained by the indirect method for shifting channels. October records have been corrected arbitrarily for backwater caused by dredge working in the vicinity of the station.

Monthly discharge of Sunnyside canal near Wapato, Wash., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April	580	380	521	31,000	A.
May	623	570	609	37,400	A.
June	642	606	620	36,900	A.
July	680	642	665	40,900	A.
August	703	650	685	42,100	A.
September	636	554	603	35,900	A.
October	598	548	554	34,100	A.
The period				258,000	

KIONA CANAL NEAR KIONA, WASH.

Kiona canal diverts water from the left bank of Yakima River, 5 miles upstream from Kiona, in sec. 10, T. 9 N., R. 20 E. It is operated by the Northern Pacific Irrigation Co. The first systematic measurements were made in 1904, the station being established June 6. The records were interrupted during 1906–7, but were begun again on May 7, 1908.

The principal value of the records is in making a study of the discharge of Yakima River at Prosser. A station was established at Prosser May 30, 1904, but on account of the impossibility of measuring the discharge at low water the station was abandoned on December 12, 1906. The flow is under the artificial control of the power plant and mills located here. The station on Kiona canal was therefore established with the intention of accounting for the inflow and diversions between Prosser and Kiona, since at the latter point reliable discharge records of long standing are available. The data herewith represents the amount diverted from Yakima River at this point.

Discharge measurements of Kiona canal near Kiona, Wash., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 7	H. D. McGlashan	5.9	12	2.05	33
Sept. 9	L. R. Allen	6	14	2.26	26
10	do	6	9.9	1.65	16
1909.					
Aug. 2	H. Kimble	5.7	13.7	2.40	33.4

Daily gage height, in feet, of Kiona canal near Kiona, Wash., for 1909.

[F. W. Rolph, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.12	2.10	2.35	2.30	2.17	1.95	16	.....	2.07	2.12	2.20	2.20	2.07	.....
2	.....	2.15	2.28	2.42	2.00	2.17	1.60	17	.....	2.12	2.07	2.12	2.20	2.08	.....
3	.....	2.25	2.28	2.55	2.00	2.05	1.60	18	.....	2.05	1.97	2.10	2.20	2.08	.....
4	.....	2.23	2.28	2.35	1.95	2.11	1.70	19	.....	2.20	1.91	2.07	2.17	2.08	.....
5	.....	2.15	2.30	2.30	2.10	2.15	1.40	20	.....	2.15	1.80	2.05	2.18	2.08	.....
6	.....	2.08	2.36	2.24	2.10	2.15	1.40	21	.....	2.10	1.75	2.03	2.20	2.10	.....
7	.....	2.03	2.35	2.24	2.10	2.15	1.40	22	.....	2.20	1.72	2.00	2.13	2.09	.....
8	.....	1.95	2.35	2.23	2.05	2.17	1.37	23	2.20	2.18	1.72	1.97	2.13	2.08	.....
9	.....	2.10	2.35	2.37	2.15	2.20	1.37	24	2.20	2.10	1.72	1.95	2.17	2.07	.....
10	.....	2.10	2.35	2.35	2.15	2.02	1.37	25	2.18	2.17	1.67	2.05	2.25	2.07	.....
11	.....	2.10	2.30	2.35	2.10	2.02	1.35	26	2.20	2.15	1.65	2.05	2.11	2.07	.....
12	.....	2.13	2.28	2.35	2.20	2.04	1.32	27	2.30	2.13	1.60	2.15	2.11	2.07	.....
13	.....	2.15	2.26	2.37	2.15	2.04	1.32	28	2.45	2.10	1.80	2.00	2.13	2.10	.....
14	.....	2.15	2.15	2.37	2.30	2.06	.....	29	2.30	2.05	1.95	1.97	2.15	1.95	.....
15	.....	2.11	2.15	2.25	2.20	2.07	.....	30	2.18	2.10	2.13	1.97	2.15	1.95	.....
								31	2.15	.....	2.25	2.02	.....	1.95	.....

NOTE.—The water was turned out on days when gage was not read and turned out for the season on Nov. 13.

Monthly discharge of Kiona canal near Kiona, Wash., for 1908–9.

Month.	Mean discharge in second-feet.	Run-off (total in acre-feet).	Accuracy.
1908.			
May 7–31	31.1	1,540	.....
June	26.5	1,580	.....
July	27.8	1,710	.....
August	25.5	1,570	.....
September	21.4	1,270	.....
October	13.8	848	.....
1909.			
May 23–31	35.7	637	.....
June	30.0	1,790	.....
July	26.3	1,620	.....
August	27.3	1,680	.....
September	24.0	1,430	.....
October	25.4	1,560	.....
Nov. 1–13	16.4	423	.....

NOTE.—These estimates were obtained from daily discharges determined by the indirect method of shifting. As there were only a very few discharge measurements made during these years, the estimates can be considered only approximate.

PRIVATE CANALS.[1]

Discharge measurements made on canals in Yakima Valley in 1909.

Canals diverting from Yakima River.

Date.	Canal.	Area of section.	Gage height.	Discharge.
	KITTITAS VALLEY.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 18	Cascade	27.4	3.45	88.8
July 22	.....do	26.9	3.40	86.3
Aug. 9	.....do	26.2	3.31	81.7
Sept. 2	.....do	27.3	3.47	86.8
June 18	West Kittitas	35.4	2.50	90
July 23	.....do	39.4	2.80	106
Aug. 10	.....do	38.1	2.73	98.8
Sept. 2	.....do	36.4	2.55	92.8
July 22	Ellensburg Water Co	39.5	2.85	127
Aug. 9	.....do	37.2	2.62	116
Sept. 2	.....do	41.2	2.95	130
June 18	Olson	14.8	1.31	32.8
July 22	.....do	9.8	.80	14.6
June 19	Bull	21.8	1.50	41.6
July 22	.....do	18.1	1.15	38.4
Aug. 10	.....do	20.2	1.32	34.9
	YAKIMA-MOXEE VALLEYS.			
June 16	Sclah-Moxee	34.8	2.67	62.6
July 23	.....do	39.7	3.14	71.2
Aug. 5	.....do	37.6	3.05	63.8
24	.....do	44.7	3.09	66.9
Sept. 23	.....do	37.5	2.83	37.3
June 16	Taylor	14.2	1.65	22.9
July 23	.....do	18	2.13	28.2
Aug. 24	.....do	14.9	1.92	19.6
Sept. 23	.....do	9.6	1.40	8.9
June 14	Moxee Co. (Moxee canal)	1.95	1.00	.7
July 13	.....do	13.1	2.42	11.1
Aug. 4	.....do	11.9	2.77	12.2
Sept. 4	.....do	10.9	2.34	6.8
June 14	Moxee Co. (Hubbard canal)	18.3	.80	29.5
July 13	.....do	17.4	.62	27.3
Aug. 4	.....do	.....	.79	28.5
Sept. 4	.....do	18.3	.73	24.4
June 15	Fowler	11.5	1.17	34.4
July 13	.....do	11.1	1.13	34.0
Aug. 4	.....do	11.6	1.18	35.3
18	.....do	.....	1.37	40.3
Sept. 4	.....do	12.8	1.31	33.8
23	.....do	12.8	1.31	33.7

NOTE.—Data for New, Old, Sunnyside, and Kiona canals are published under separate station headings. See table of contents.

[1] For location of headworks of these canals see table on pp. 232–233.

Discharge measurements made on canals in Yakima Valley in 1909—Continued.

Canals diverting from Naches River.

Date.	Canal.	Area of section.	Gage height.	Discharge.
	ABOVE TIETON RIVER.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 8	Selah Valley	52.5	2.12	105
July 21	do	54.1	2.20	108
29	do	54.9	2.23	102
Sept. 11	do	57.8	2.31	108
27	do	42.1	1.50	66.9
	BETWEEN TIETON RIVER AND COWICHE CREEK.			
July 1	Wapatox power canal (at intake)	72.7	1.70	184
21	do	71.9	1.65	172
29	do	70.9	1.63	172
Sept. 27	do	71.4	1.73	167
June 9	Wapatox power canal (at power house)	44.2	2.28	132
July 22	do	44.9	2.25	133
Aug. 20	do	42.6	2.17	122
June 9	Lower Wapatox	6.44	1.37	15.7
July 22	do	6.75	1.43	17.8
Aug. 20	do	6.44	1.40	16.2
June 23	Clark	3.04	.83	2.67
July 21	do	5.57	1.27	6.78
June 8	Upper Scott	7.92	1.23	7.36
23	do	8.82	1.30	7.37
	do	10.6	1.51	12.4
22	Lowery	5.35	.97	4.0
July 20	do	3.4	1.00	4.02
29	do	7.0	1.41	8.8
June 22	Kelly	4.1	.84	5.76
July 21	do	4.7	.93	7.0
29	do	6.9	1.32	14.1
June 8	Fortune	8.63	1.50	18.6
23	do	4.52	.80	6.78
July 20	do	9.3	1.63	21.0
Sept. 28	do	7.42	1.30	12.9
June 9	Gleed	37.6	2.50	69.6
23	do	36.6	2.35	60.8
July 22	do	39.5	2.52	73.9
Aug. 20	do	39.6	2.44	67.0
Sept. 9	do	36.0	2.14	50.5
June 8	Congdon or Yakima Valley	20.5	2.00	53.0
July 7	do	21.6	2.03	54.1
Sept. 21	do	14.8	1.30	31.1
June 10	Naches-Cowiche	18.2	2.34	28.3
July 7	do	19.9	2.51	33.9
Aug. 4	do	21.1	2.58	32.8
21	do	21.1	2.52	28.1
Sept. 7	do	20.0	2.50	29.5
21	do	12.5	1.73	13.6
	BELOW COWICHE CREEK.			
June 10	Fruitvale Schanno	8.0	.80	13.6
26	do	9.1	.91	18.0
Aug. 4	do	9.5	.91	18.2
Sept. 7	do	11.0	1.08	24.0
June 11	R. S. & C	2.9	.70	8.25
Aug. 6	do	1.87	.45	3.55
June 11	Schanno	12.8	.86	24.6
26	do	9.7	.67	18.0
Aug. 4	do	12.0	.80	23.0
6	do	12.2	.82	23.6
June 12	Broadgage	3.76	.74	6.76
26	do	4.3	.88	8.48
Aug. 6	do	3.35	.70	5.6
21	do	5.2	1.00	10.4
June 10	Union	30.8	2.77	35.9
July 7	do	32.1	2.90	38.3
Aug. 4	do	28.8	2.58	23.1
21	do	33.8	2.90	34.4
Sept. 7	do	28.5	2.56	26.5
21	do	34.0	2.96	33.8
June 10	North Yakima Town	9.6	1.46	15.7
Aug. 21	do	8.5	1.33	4.2
Sept. 3	do	11.3	1.83	5.3

NOTE.—The discharge of the Wapatox power canal at intake minus that at the power house equals the amount in the upper Wapatox canal diverted for irrigation.

Discharge measurements made on canals in Yakima Valley in 1909—Continued.

Canals diverting from Natches River—Continued.

Date.	Canal.	Area of section.	Gage height.	Discharge.
		Sq. ft.	*Feet.*	*Sec.-ft.*
June 12	Naches Avenue, Union	10.8	1.39	30.7
July 9	do	2.8	.19	.7
Aug. 19	do	11.8	1.54	34.6
Sept. 7	do	11.7	1.48	32.8
June 12	North Yakima mill waste	2.59	1.34	53.2
July 9	do	8.3	.21	12.1
12	do	19.9	1.31	41.6
Aug. 5	do	6.5	.12	7.2
6	do	18.3	.98	37.4
19	do	20.9	1.16	42.7
Nov. 20	do	29.1	1.74	73.7
July 12	North Yakima power waste	17.4	.97	63.2
Aug. 5	do	5.3	.28	5.6
	do		.77	4.7

Ditches diverting water from upper Naches River (on August 17, 1909).

Ditch.	Diverts from—	Bank of stream.	Location above Naches.	Length.	Size of head gate.	Size of ditch.	Acreage.		Discharge.
							Irrigated.	Additional irrigable.	
			Miles.	*Miles.*	*Feet.*	*Feet.*			*Sec.-ft.*
Davison	Spring		28				1		
Anderson	Gold Creek		25				100		0.5
John Enrich	Small creek just above Rock Creek.		23				(a)		
Upper Benton [b]	Naches River	Left	20	$\frac{3}{4}$	4 by 5	3 wide	16	None.	1.0
Lower Benton	do	do	[c] 19	$\frac{1}{2}$	3 by 4	3 wide	7	15	[d] 1.2
Carmack & Heigh.	do	Right	$14\frac{1}{2}$		None.	3 by 1	40	60	.75
Hunting & Freeland.	do	Left	14	1		4 wide	100		(e)
Griffin	do	Right	13	$\frac{1}{2}$		3 wide	30	40	(e)
Stevens	do	Left	12	$\frac{3}{4}$		3 wide	40		
Meloy	do	Right	11	$\frac{3}{4}$		4 wide	50	10	[d] 1.4
Markel & Andrews. [f]	do	do	[c] $18\frac{1}{2}$	2		[g] 3 by 1.2	70	30	[h] 8.2
Lindsay & Markel. [i]	do	do	[j] 18	1	None.		(a)	[k] 70	(l)
Johnson	Nile Creek		17				15		
Williams & Abel. [m]	Big Rattlesnake Creek (1 mile above mouth).		16	2		6 by 1	220	130	[n] 4.5
Beck	Little Rattlesnake Creek.		[o] $15\frac{1}{2}$	$\frac{1}{2}$	None.	4 wide	25	60	2.6

[a] None in 1909.
[b] Z. H. Benton also irrigates about 6 acres from another small creek. This supply fails about Aug. 1.
[c] One-half mile above road bridge.
[d] About half full.
[e] Nearly dry.
[f] J. H. Andrews has also 25 acres that can be irrigated by pumping from this ditch.
[g] Flume.
[h] Full.
[i] The flood of 1906 changed the river channel so that it is difficult to divert water into this ditch during low water. The ditch has not been used much since that time.
[j] Just below highway bridge.
[k] This is now irrigated from Nile Creek.
[l] Not in use.
[m] A. R. Abel irrigates partly from Nile Creek at present.
[n] Nearly full.
[o] Near highway bridge.

Monthly discharge of canals in Yakima Valley in 1909.[a]

Cascade canal near Thorp, Wash.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July	88	0	86.2	5,300
August	90	79.2	87.6	5,390
September	90	81.3	86.7	5,160
The period	90	0	86.8	15,800

West Kittitas canal near Thorp, Wash.

July	106	0	92.5	5,690
August	102	67	96.2	5,920
September	90	57	74.5	4,430
The period	106	0	87.7	16,000

Ellensburg Water Co. canal near Ellensburg, Wash.

July	142	103	125	7,690
August	140	0	123	7,560
September	130	88	108	6,430
The period	142	0	119	21,700

Olson canal near Ellensburg, Wash.

July	40	14.	24.6	1,510
August	30	12.5	21.6	1,330
September	18	6.1	10.7	637
The period	40	6.1	19.0	3,480

Bull canal near Ellensburg, Wash.

July	44	35	38.1	2,340
August	38	0	31.7	1,950
September	37	27	33.4	1,990
The period	44	0	34.4	6,280

Selah-Moxee canal near Selah, Wash.

July	74	63.5	68.6	4,220
August	70	60.4	66.7	4,100
September	66	26	48.3	2,870
The period	74	26	61.2	11,200

Taylor canal near Selah, Wash.

July	30	17.9	24.9	1,530
August	28	15.6	20.1	1,240
September	16	4.5	10.2	607
The period	30	4.5	18.4	3,380

Moxee Co. canal near North Yakima, Wash.[b]

July	38	.....	35.1	2,160
August	41	.....	32.2	1,980
September	34	.....	19.8	1,180
The period	41	.....	29.0	5,320

[a] For location of head gates of these canals see table on pp. 232–233.
[b] This includes the combined flow of the Moxee and Hubbard canals.

Monthly discharge of canals in Yakima Valley—Continued.

Fowler canal near North Yakima, Wash.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July	42	22.8	36.2	2,230
August	46	24	37.5	2,310
September	38	18.8	31.4	1,870
The period	46	18.8	35.0	6,410

Granger canal near North Yakima, Wash.[a]

July			6	369
August			6	369
September			2	119
The period			4.7	857

Selah Valley canal near Naches, Wash.

July	109	102	107	6,580
August	107	104	106	6,520
September	107	67	91	5,410
The period	109	67	101	18,500

Upper Wapatox canal near Naches, Wash.[b]

July			43	2,640
August			39	2,400
September			39	2,320
The period			40.3	7,360

Lower Wapatox canal near Naches, Wash.

July	18	15.5	16.7	1,030
August	16.5	16.5	16.5	1,010
September	16.5	6.5	10.2	607
The period	18	6.5	14.5	2,650

Clark canal near Naches, Wash.[a]

July			7	430
August			7	430
September			6	357
The period			6.7	1,220

Upper Scott canal near Naches, Wash.

July	15	0	11.5	707
August	18	10.9	13.9	855
September	14	0	6.4	381
The period	18	0	10.6	1,940

[a] Miscellaneous station. Discharges estimated.

[b] Values given for this station refer to amounts used for irrigation. They have been obtained by subtracting the discharge at the regular power-house station from the regular station at the intake.

NOTE.—Data for New, Old, Sunnyside, and Kiona canals are published under separate station headings. See table of contents.

Monthly discharge of canals in Yakima Valley in 1909—Continued.

Lowery canal near Naches, Wash.

Month.	Discharge in second-feet.			Run-off (total in acre feet).
	Maximum.	Minimum.	Mean.	
July	10	1.5	6.9	424
August	7	3.2	5.8	357
September	8	5.4	6.4	381
The period	10	1.5	6.4	1,160

Kelly canal near Naches, Wash.

July	19	6.2	12.6	775
August	13	6.5	9.7	596
September	16	5.7	9.7	577
The period	19	5.7	10.7	1,950

Fortune canal near Naches, Wash.

July	25	12	19.5	1,200
August	20	9.6	16.7	1,030
September	24	5.5	14.7	875
The period	25	5.5	17.0	3,100

Lower Scott canal near Naches, Wash.[a]

July	.....	.....	10	615
August	.....	.....	10	615
September	.....	.....	8	476
The period	.....	.....	9.3	1,710

Gleed canal near Naches, Wash.

July	79	36	61.5	3,780
August	73	53	62.5	3,840
September	58	24	42.9	2,550
The period	79	24	55.6	10,200

Morrisey canal near Naches, Wash.[a]

July	.....	.....	3	184
August	.....	.....	3	184
September	.....	.....	2	119
The period	.....	.....	2.7	487

Congdon canal near Naches, Wash.

July	55	48	52	3,200
August	55	.....	52	3,200
September	53	22.7	40	2,380
The period	55	.....	48	8,780

White & Leach canal near Naches, Wash.[a]

July	.....	.....	4	246
August	.....	.....	4	246
September	.....	.....	3	178
The period	.....	.....	3.7	670

[a] Miscellaneous station. Discharge estimated.

Monthly discharge of canals in Yakima Valley in 1909—Continued.

McCormick canal near Naches, Wash.[a]

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July			6	369
August			6	369
September			3.3	196
The period			5.1	934

Sculler & Rodenbach canal near North Yakima, Wash.[a]

July			4	246
August			4	246
September			3	178
The period			3.7	670

Naches-Cowiche canal near North Yakima, Wash.

July	44	13	31.6	1,940
August	37	17.5	30	1,840
September	29	10	18.3	1,090
The period	44	10	26.6	4,870

Fruitvale Schanno canal at North Yakima, Wash.

July	25	1	18	1,110
August	30	5	19.9	1,220
September	25	2	16.1	958
The period	30	1	18.0	3,290

R. S. & C. canal at North Yakima, Wash.

July	14	3.5	8.4	516
August	15		8	492
September	11	6	7.9	470
The period	15		8.1	1,480

Schanno canal at North Yakima, Wash.

July	27	3.5	21.2	1,300
August	27	3.5	20.5	1,260
September	21	17.3	19.3	1,150
The period	27	3.5	20.3	3,710

Broadgage canal near North Yakima, Wash.

July	14	4.6	10.5	646
August	14	.0	10.4	640
September	10	.0	6.1	363
The period	14		9.0	1,650

Union canal at North Yakima, Wash.[b]

July	68		51.3	3,150
August	70		57.4	3,530
September	66		51.6	3,070
The period	70		53.4	9,750

[a] Miscellaneous station. Discharge estimated.
[b] The values for this station are the sum of those for the two regular stations on the Old Union and Naches Avenue Union canals.

Monthly discharge of canals in Yakima Valley in 1909—Continued.

North Yakima Town canal at North Yakima, Wash.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).
	Maximum.	Minimum.	Mean.	
July	17	75	11.5	707
August	20	0	8.9	547
September	10	5	6.4	381
The period	20	.....	8.9	1,640

Summary of monthly run-off, in acre-feet, of canals in Yakima Valley for 1909.

Canal.	Nearest town.	July.	August.	September.	Total for period.
DIVERSIONS FROM YAKIMA RIVER.					
Kittitas Valley:					
Cascade	Thorp	5,300	5,390	5,160	15,800
West Kittitas	do	5,690	5,920	4,430	16,000
Ellensburg Water Co.	Ellensburg	7,690	7,560	6,430	21,700
Olson	do	1,510	1,330	637	3,480
Bull	do	2,340	1,950	1,990	6,280
Total Kittitas Valley diversions		2,250	2,220	18,600	63,300
Yakima-Moxee Valleys:					
Selah-Moxee	Selah	4,220	4,100	2,870	11,200
Taylor	do	1,530	1,240	607	3,380
Moxee Co.[a]	North Yakima	2,160	1,980	1,180	5,320
Fowler	do	2,230	2,310	1,870	6,410
Granger	do	369	369	119	857
Total Yakima-Moxee Valleys diversions		10,500	10,000	6,650	27,200
Indian Reservation Basin:					
New Reservation[b]	Yakima	.....	.....	.....	.....
Old Reservation[b]	Wapato	.....	.....	.....	.....
Sunnyside[b]	do	.....	.....	.....	.....
Lower Yakima Valley:					
Kiona[b]		.....	.....	.....	.....
DIVERSIONS FROM NACHES RIVER.					
Above Tieton River:					
Selah Valley	Naches	6,580	6,520	5,410	18,500
Between Tieton River and Cowiche Creek:					
Upper Wapatox	do	2,640	2,400	2,320	7,360
Lower Wapatox	do	1,030	1,010	607	2,650
Clark	do	430	430	357	1,220
Upper Scott	do	707	855	381	1,940
Lowery	do	424	357	381	1,160
Kelly	do	775	596	577	1,950
Fortune	do	1,200	1,030	875	3,100
Lower Scott	do	615	615	476	1,710
Gleed	do	3,780	3,840	2,550	10,200
Morrisey	do	184	184	119	487
Congdon	do	3,200	3,200	2,380	8,780
White & Leach	do	246	246	178	670
McCormick	do	369	369	196	934
Sculler & Rodenbach	North Yakima	246	246	178	670
Naches-Cowiche	do	1,940	1,840	1,090	4,870
Total diversions between Tieton River and Cowiche Creek		17,800	17,200	12,700	47,700
Below Cowiche Creek:					
Fruitvale Shanno	North Yakima	1,110	1,220	958	3,290
R. S. & C.	do	516	492	470	1,480
Schanno	do	1,300	1,260	1,150	3,710
Broadgage	do	646	640	363	1,650
Union	do	3,150	3,530	3,070	9,750
North Yakima town	do	707	547	381	1,640
Total diversions below Cowiche Creek		4,730	7,690	6,390	21,500

[a] Includes flow of Moxee and Hubbard Canals.

[b] See note, page 245.

SNAKE RIVER DRAINAGE BASIN.

DESCRIPTION.

Snake River, the largest tributary of the Columbia, rises among the high peaks of the Rocky Mountains in Yellowstone National Park, western Wyoming and northeastern Idaho, heading in the divide from which streams flow northward and eastward into the Missouri and southward and westward to the Colorado and the lakes of the Great Basin. From Shoshone, Lewis, and Hart lakes, in Yellowstone National Park, the South Fork of the river flows southward, broadening into Jackson Lake (4 miles wide and 18 miles long) and passing through Jackson Valley (8 miles wide and 40 miles long), beyond which, near the Idaho-Wyoming line, it enters a long canyon. In the southern part of Fremont County, Idaho, it receives the North Fork. Below the junction of the forks the Snake flows westward across Idaho to a point near Homedale, near the Oregon-Idaho line, where it turns abruptly northward and forms for about 170 miles the boundary between Idaho and Oregon, and for 30 miles more that between Idaho and Washington. At Lewiston it crosses into Washington, flows northwest, west, and southwest, and joins the Columbia near Pasco.

Practically all the important tributaries of Snake River have their sources in the high mountains, which are heavily timbered. The most heavily timbered areas are those at the head of the South Fork in the Yellowstone Park region, the upper areas of Teton, Fall, and North Fork of Snake rivers in southeastern Idaho, and those of upper Boise and Payette rivers in central Idaho.

Precipitation in the Snake River drainage area ranges from 6 or 8 inches in the valley to 50 inches at the head of many of the tributaries. In the higher altitudes the precipitation is practically all in the form of snow, but the snowfall in the lower valleys, below American Falls, Idaho, is comparatively light. During the last few years there has been considerable rainfall, and dry farming has been practiced successfully in the valleys in the vicinity of Idaho Falls, Blackfoot, and St. Anthony, Idaho. The temperature in these valleys ranges from 100° in the summer to 35° below zero in the winter; in the Twin Falls and Boise valleys the temperature ranges from approximately 110° in the summer to zero in the winter.

The driest year ever known in the drainage basin was 1905; the wet years were 1896, 1899, 1904, 1907, and 1909.

Snake River basin has many feasible storage sites, but only a very few have been developed. About 300,000 acre-feet can be stored in Jackson Lake by a temporary dam which has been constructed by the United States Reclamation Service. The largest site is at Swan Valley on the South Fork of Snake, and the water available for

storage is approximately 4,000,000 acre-feet. Reservoir sites are also found on North Fork of Snake, Fall, Teton, Boise, and Payette rivers. Many of these sites will, no doubt, be used at some future time by the United States Reclamation Service in connection with the Minidoka and Payette-Boise projects.

Although irrigation has reached a high stage of development in the Snake River valley, approximately 6,000,000 acre-feet of water annually is unutilized. Eventually these flood waters will be stored and used to irrigate thousands of acres of arid land.

The streams afford enormous water powers, but only a few sites have been developed owing to the lack of market. Large power plants have been installed on Payette, Boise, and Snake rivers at American Falls, Shoshone Falls, and at the Minidoka dam, and many other smaller plants are also in use. (See Pl. VI.)

The upper drainage basin of the South Fork comprises the timbered mountainous country west and southwest of Yellowstone Lake. The east side of its valley is bounded by the Wind River Range, from the slopes of which it receives a large number of tributaries, and the west side by the high Teton Mountains. Most of the drainage from Teton Mountains flows westward through Teton River into North Fork.

Below the junction of North and South forks the Snake receives many tributaries, the most important of which are listed in the following table:

Principal tributaries of Snake River.

From the left (going downstream).	From the right (going downstream).
Willow Creek.	North (or Henry) Fork Teton River.
Blackfoot River.	Malade (or Big Wood) River.
Port Neuf River.	Boise River.
Raft River.	Payette River.
Goose Creek.	Weiser River.
Rock Creek.	Salmon River.
Salmon Falls River.	Clearwater River.
Bruneau River.	Palouse River..
Owyhee River.	
Malheur River. .	
Alder Creek.	
Powder River.	
Imnaha River.	
Grande Ronde River.	
Tucannon River.	

SOUTH FORK OF SNAKE RIVER AT MORAN, WYO.

This station, which was established September 21, 1903, to determine the amount of water available for storage at Jackson Lake, is located just back of the discontinued post office at Moran, Wyo., and about three-fourths of a mile below the United States Reclamation Service dam at the outlet of Jackson Lake.

A. SPILLWAY OF MINIDOKA DAM, SNAKE RIVER, IDAHO, NEAR SOUTH END.

B. MILNER RAPIDS ON SNAKE RIVER, IDAHO, SHOWING LAVA WALLS.

No tributaries enter and no water is diverted between the station and the Jackson Lake reservoir, so that the record shows only the water flowing over the reclamation dam. The principal tributaries below the station are Buffalo, Gros Ventre, John Day, and Salt rivers.

Discharge measurements are made from a car and cable about 150 feet below the inclined staff gage.

The gage heights are not affected by ice or by artificial control below the station, but some irregularity in daily flow is caused by the opening and closing of the gates at the dam above. The gage datum has remained unchanged since the establishment of the station.

A slight change of bed was observed after the spring floods of 1909, but the new rating curve is well defined and the records may be considered excellent.

Discharge measurements of South Fork of Snake River at Moran, Wyo., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 29	E. S. Fuller	205	1,060	3.50	2,660
Aug. 20	E. C. La Rue	206	1,030	4.15	3,500
21	do	206	986	3.95	3,200
22	do	205	945	3.75	2,900

Daily gage height, in feet, of South Fork of Snake River at Moran, Wyo., for 1909.

[Mrs. Maria Allen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	1.55	.....	1.35	4.45	8.0	6.5	2.85	.....	1.9	2.2
2	1.3	.....	.....	1.35	1.35	4.65	7.7	6.3	2.85	.....	1.85	2.2
3	.....	1.6	1.55	1.35	1.4	4.95	7.5	6.3	2.8	.....	1.85	2.2
4	1.3	.....	.....	.....	1.45	5.45	7.4	6.3	2.8	.....	1.75	2.2
5	.....	.....	1.55	1.35	1.5	5.9	6.55	6.4	2.7	1.0	1.75	2.2
6	1.3	1.6	1.55	.....	1.55	6.25	2.15	6.25	2.65	1.2	1.7	2.05
7	.....	1.6	1.55	1.35	1.55	6.7	2.0	6.2	2.65	1.4	1.7	2.05
8	.....	.....	1.5	.....	1.6	6.85	2.0	6.2	2.6	1.55	1.7	2.0
9	1.3	.....	1.5	1.35	1.65	6.75	2.25	6.25	2.6	2.45	1.7	2.0
10	1.35	1.6	.....	1.35	1.7	6.65	2.35	6.4	2.55	2.55	1.7	2.0
11	1.35	.....	1.45	.....	1.75	6.55	2.55	6.75	2.5	2.65	1.65	2.0
12	.....	.....	.....	1.35	1.75	6.4	2.75	6.55	2.5	2.75	1.65	2.0
13	1.45	1.6	1.45	.....	1.8	6.3	3.0	6.35	2.5	2.65	1.65	2.0
14	1.55	1.6	1.45	1.35	1.85	6.4	3.2	6.0	2.55	2.55	1.65	.....
15	1.6	.....	1.45	.....	1.95	6.55	3.5	5.5	2.55	2.4	1.6	2.0
16	1.7	1.6	.....	1.3	1.95	6.85	3.65	5.3	2.4	2.3	1.6	.....
17	1.7	.....	1.4	1.3	2.0	7.15	3.8	5.7	2.45	2.3	1.6	.....
18	.....	1.6	.....	.....	2.05	7.45	4.05	4.6	2.45	2.35	1.6	2.0
19	1.7	.....	.....	1.3	2.15	7.75	4.05	4.35	2.3	2.2	1.6	1.95
20	1.7	1.6	1.4	1.3	2.25	7.9	4.05	4.1	2.3	2.15	1.6	1.95
21	.....	.....	.....	1.3	2.25	8.0	4.0	3.9	2.35	2.15	1.75	1.9
22	1.75	1.6	1.4	.....	2.35	8.05	4.0	3.75	2.35	2.1	1.8	1.85
23	1.75	.....	.....	1.3	2.45	8.05	3.7	3.65	2.2	2.05	1.85	1.7
24	1.75	1.55	1.35	1.3	2.6	8.05	3.55	3.55	2.25	2.0	2.05	1.75
25	1.75	.....	1.35	1.3	2.75	8.05	3.35	3.45	2.1	2.0	2.2	1.75
26	.....	.....	.....	.....	2.95	8.15	3.4	3.35	2.1	2.0	2.35	1.7
27	1.7	1.55	1.35	.....	3.35	8.15	3.5	3.15	1.0	1.95	2.3	1.7
28	1.7	1.55	.....	1.3	3.55	8.2	3.5	3.05	.....	1.95	2.25	1.7
29	1.65	.....	1.35	.....	3.85	8.25	3.5	2.95	.....	1.95	2.25	.....
30	1.65	.....	.....	1.3	4.0	8.25	3.4	2.9	.....	1.9	2.2	1.7
31	.....	.....	1.35	.....	4.25	.....	3.4	2.85	.....	1.9	.....	1.65

NOTE.—Head-gates at Jackson Lake shut tight Sept. 28 to Oct. 4.

Daily discharge, in second-feet, of South Fork of Snake River at Moran, Wyo., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	590	788	754	622	622	3,780	10,300	7,370	1,910	0	1,070	1,310
2	590	788	754	622	622	4,080	9,700	6,990	1,910	0	1,030	1,310
3	590	788	754	622	653	4,540	9,300	6,990	1,800	0	1,030	1,310
4	590	788	754	622	686	5,340	9,100	6,990	1,800	0	955	1,310
5	590	788	754	622	719	6,120	7,400	7,180	1,760	470	955	1,310
6	590	788	754	622	754	6,750	1,270	6,900	1,710	590	920	1,190
7	590	788	754	622	754	7,570	1,150	6,810	1,710	710	920	1,190
8	590	788	719	622	788	7,860	1,150	6,810	1,600	815	920	1,150
9	590	788	719	622	824	7,660	1,350	6,900	1,600	1,520	920	1,150
10	622	788	702	622	859	7,480	1,440	7,180	1,620	1,620	920	1,150
11	622	788	686	622	896	7,290	1,620	7,840	1,570	1,710	885	1,150
12	654	788	686	622	896	7,020	1,810	7,400	1,570	1,810	885	1,150
13	686	788	686	622	932	6,840	2,070	7,080	1,570	1,710	885	1,150
14	754	788	686	622	970	7,020	2,290	6,450	1,620	1,620	885	1,150
15	788	788	686	606	1,050	7,290	2,640	5,590	1,620	1,480	850	1,150
16	859	788	670	590	1,050	7,860	2,820	5,250	1,480	1,390	850	1,150
17	859	788	653	590	1,080	8,420	3,020	5,930	1,520	1,390	850	1,150
18	859	788	653	590	1,120	9,000	3,350	4,140	1,520	1,440	850	1,150
19	859	788	653	590	1,200	9,600	3,350	3,770	1,390	1,310	850	1,110
20	859	788	653	590	1,290	9,900	3,350	3,420	1,390	1,270	850	1,110
21	878	788	653	590	1,290	10,100	3,280	3,150	1,440	1,270	955	1,070
22	896	788	653	590	1,370	10,200	3,280	2,900	1,440	1,230	990	1,030
23	896	771	638	590	1,400	10,200	2,890	2,820	1,310	1,190	1,030	920
24	896	754	622	590	1,590	10,200	2,700	2,700	1,350	1,150	1,190	955
25	896	754	622	590	1,730	10,200	2,460	2,580	1,230	1,150	1,310	955
26	878	754	622	590	1,920	10,400	2,520	2,460	1,230	1,150	1,440	920
27	859	754	622	590	2,340	10,400	2,640	2,240	470	1,110	1,390	920
28	859	754	622	590	2,580	10,500	2,640	2,120	0	1,110	1,350	920
29	824	.....	622	590	2,950	10,600	2,640	2,020	0	1,110	1,350	920
30	824	.....	622	590	3,140	10,600	2,520	1,900	0	1,070	1,310	920
31	806	.....	622	.....	3,490	.....	2,520	1,910	.....	1,070	.....	885

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to June 30, 1909, well defined below 7,000 second-feet; July 1 to Dec. 31, 1909, well defined below 7,400 second-feet.

Monthly discharge of South Fork of Snake River at Moran, Wyo., for 1909.

[Drainage area, 820 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	896	590	750	0.915	1.05	46,100	A.
February	788	754	781	.952	.99	43,400	A.
March	754	622	679	.828	.95	41,800	A.
April	622	590	605	.738	.82	36,000	A.
May	3,490	622	1,340	1.63	1.88	82,400	A.
June	10,600	3,780	8,160	9.95	11.10	486,000	A.
July	10,300	1,150	3,500	4.27	4.92	215,000	A.
August	7,840	1,910	4,970	6.06	6.99	306,000	A.
September	1,910	0	1,380	1.68	1.87	82,100	A.
October	1,810	0	1,080	1.32	1.52	66,400	A.
November	1,440	850	1,020	1.24	1.38	60,700	A.
December	1,310	885	1,100	1.34	1.54	67,600	A.
The year	10,600	0	2,110	2.58	35.01	1,530,000	

SOUTH FORK OF SNAKE RIVER NEAR LYON, IDAHO.

This station, which was established April 18, 1903, is located just below the highway bridge between Conant and Swan valleys, about 2 miles below the lower end of Swan Valley.

As the South Fork of Snake River receives no tributaries below this point the records show the total amount of water available from

the South Fork for irrigation below and for storage in the Swan Valley reservoir site just above. Between this station and Jackson Lake above a number of important tributaries enter, the run-off at Lyon being about four times that at Moran. Chief among these tributaries are Buffalo River, which enters about 2 miles below Moran; Gros Ventre River, which comes in near Jackson, Wyo., about 30 miles below Moran; and John Day and Salt rivers, which enter near the Idaho-Wyoming line, about 60 miles below Moran. A small amount of water is diverted above this station for irrigation on small ranches along the river.

The inclined staff gage is located on the north bank about 300 feet below the iron bridge and 1 mile above the cable station. The gage datum remained unchanged from October 16, 1904, to August 25, 1909. On August, 25, 1909, a chain gage was constructed directly across the river from the inclined gage. Readings on this gage from August 26 to December 31, 1909, have been corrected by a constant equation to make them comparable with previous readings.

Discharge measurements are made by means of a cable equipment at the old site of Wedekinds Ferry.

Winter records are affected by ice. In the daily flow artificial control above causes some irregularities, but there is no effect from artificial control below.

A slight shifting of channel was observed after the spring floods of 1909, but a good rating curve has been obtained and the records may be considered excellent.

Discharge measurements of South Fork of Snake River near Lyon, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 1	W. M. O'Neill	260	1,520	1.58	3,470
Aug. 1	G. T. Burridge	282	2,450	5.40	11,900
2	.....do	288	2,580	5.85	14,300
3	.....do	293	2,740	6.40	16,900
4	.....do	292	2,700	6.25	15,800
5	.....do	292	2,710	6.20	16,000
6	.....do	291	2,680	6.15	15,600
7	.....do	291	2,680	6.15	15,600
8	.....do	290	2,660	6.10	15,300
9	.....do	290	2,660	6.00	14,900
10	.....do	290	2,640	5.95	14,800
11	.....do	290	2,640	6.00	14,700
12	.....do	291	2,670	6.10	15,700
13	.....do	291	2,660	6.05	15,200
14	.....do	288	2,620	5.90	14,400
15	.....do	287	2,560	5.70	13,500
16	.....do	286	2,520	5.55	13,000
17	.....do	283	2,470	5.30	12,100
18	.....do	282	2,410	5.15	11,100
19	.....do	280	2,340	4.95	10,300
20	.....do	280	2,330	4.80	9,920
21	.....do	279	2,280	4.65	9,400
22	.....do	277	2,240	4.50	8,790
23	.....do	277	2,240	4.50	8,840
24	.....do	277	2,250	4.55	9,130
25	.....do	277	2,240	4.45	8,740
26	.....do	276	2,200	4.30	8,000
27	.....do	276	2,160	4.15	7,600
28	.....do	274	2,130	4.05	7,140
29	.....do	274	2,100	4.05	7,010
30	.....do	273	2,090	3.95	6,740
31	.....do	273	2,090	3.90	6,790
Oct. 25	O'Neill and Hartwell	262	2,000	3.16	4,620

Daily gage height in feet, of South Fork of Snake River near Lyon, Idaho, for 1909.

[Richard Later, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	.....	1.4	2.9	7.7	10.45	5.4	4.0	2.9	2.9	3.15
2	.....	1.6	.....	1.45	3.0	8.1	10.35	5.85	4.25	2.9	2.9	3.1
3	.....	1.6	.....	1.5	3.15	8.8	10.25	6.4	4.2	2.85	2.9	2.95
4	.....	1.6	.....	1.5	3.9	9.7	10.1	6.25	4.1	2.9	2.9	3.05
5	.....	1.6	.....	1.5	5.0	10.2	10.05	6.2	3.95	2.9	2.85	3.0
6	.....	1.6	.....	1.6	4.4	10.6	10.0	6.15	4.1	2.9	2.85	2.95
7	.....	.....	.....	1.6	4.1	.....	9.6	6.15	4.2	2.9	2.8	2.95
8	1.0	.....	.....	1.6	4.4	.....	9.0	6.1	4.1	2.95	2.8	3.0
9	1.0	.....	.....	1.7	4.7	.....	8.7	6.0	4.0	3.05	2.8	2.9
10	1.2	.....	.....	1.75	5.3	.....	8.3	5.95	3.9	3.15	2.85	2.9
11	1.25	.....	.....	2.05	5.5	.....	8.0	6.0	3.9	3.2	2.85	2.9
12	1.3	.....	.....	2.0	5.0	.....	7.8	6.1	3.95	3.2	2.85	2.9
13	1.4	.....	.....	2.0	4.5	9.7	7.45	6.05	3.95	3.2	2.85	2.85
14	1.5	.....	.....	1.9	4.4	9.8	7.1	5.9	3.9	3.25	2.9	2.9
15	1.6	.....	.....	1.85	4.8	10.0	6.7	5.7	3.9	3.25	2.9	2.9
16	1.7	.....	.....	1.85	4.5	10.1	6.4	5.55	3.8	3.2	2.9	2.95
17	1.8	.....	.....	.....	4.4	10.25	6.2	3.3	3.7	3.2	2.9	2.9
18	1.7	.....	.....	.....	4.2	10.65	6.0	5.15	3.65	3.2	2.9	2.85
19	1.6	.....	.....	.....	4.5	10.9	5.95	4.95	3.6	3.2	2.9	2.85
20	1.8	.....	.....	.....	4.9	10.9	5.8	4.8	3.55	3.15	2.9	2.8
21	1.7	.....	.....	.....	5.5	10.85	5.7	4.65	3.5	3.1	3.1	2.8
22	1.75	.....	.....	2.1	5.9	10.45	5.6	4.5	3.9	3.1	3.4	2.9
23	1.75	.....	.....	2.25	6.6	10.3	5.45	4.5	3.4	3.1	4.3	2.85
24	1.6	.....	.....	2.4	6.2	10.2	5.6	4.55	3.4	3.05	4.1	2.85
25	1.6	.....	.....	3.0	6.5	10 1	5.5	4.45	3.4	3.0	3.9	2.9
26	1.6	.....	.....	3.1	7.0	10.3	5.4	4.3	3.4	3.0	3.5	.....
27	1.6	.....	.....	3.45	7.8	10.3	5.6	4.15	3.3	2.95	3.2	.....
28	1.6	.....	.....	3.7	8.0	10.45	5.6	4.05	3.2	2.95	3.2	.....
29	1.6	.....	1.3	3.4	7.8	10.65	5.5	4.05	3.1	2.95	3.15	.....
30	1.6	.....	1.35	3.1	.....	10.65	5.4	3.95	2.9	2.95	3.15	.....
31	1.6	.....	1.35	.....	7.2	.....	5.3	3.9	.....	2.9	.....	.....

NOTE.—The water did not reach the gage Jan. 1–7 because of a sand bar. Open-channel conditions Jan. 8–24. Frozen at the gage Jan. 25 to Mar. 28. River probably not frozen over. Gage not read Apr. 17–21. Gage heights June 7–12 uncertain.

Daily discharge, in second-feet, of South Fork of Snake River near Lyon, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	.....	.....	2,860	5,750	25,400	38,800	12,300	7,060	4,070	4,070	4,660
2	.....	.....	.....	2,930	5,980	27,600	38,300	14,300	7,880	4,070	4,070	4,540
3	.....	.....	.....	3,000	6,340	31,600	37,700	16,800	7,710	3,960	4,070	4,180
4	.....	.....	.....	3,000	8,450	36,900	36,900	16,100	7,380	4,070	4,070	4,420
5	.....	.....	.....	3,000	12,500	39,800	36,600	15,900	6,900	4,070	3,960	4,300
6	.....	.....	.....	3,160	10,200	42,200	36,300	15,600	7,380	4,070	3,960	4,180
7	.....	.....	.....	3,160	9,080	41,500	34,100	15,600	7,710	4,070	3,850	4,180
8	2,340	.....	.....	3,160	10,200	40,800	30,700	15,400	7,380	4,180	3,850	4,300
9	2,340	.....	.....	3,320	11,300	40,100	29,000	15,000	7,060	4,420	3,850	4,070
10	2,580	.....	.....	3,410	13,800	39,300	26,800	14,700	6,750	4,660	3,960	4,070
11	2,650	.....	.....	3,970	14,600	38,500	25,200	15,000	6,750	4,790	3,960	4,070
12	2,720	.....	.....	3,870	12,500	37,700	24,000	15,400	6,900	4,790	3,960	4,070
13	2,860	.....	.....	3,870	10,500	36,900	22,200	15,200	6,900	4,790	3,960	3,960
14	3,000	.....	.....	3,680	10,200	37,500	20,400	14,500	6,750	4,920	4,070	4,070
15	3,160	.....	.....	3,590	11,700	38,600	18,400	13,600	6,750	4,920	4,070	4,070
16	3,320	.....	.....	3,590	10,500	39,200	16,800	13,000	6,450	4,790	4,070	4,180
17	3,500	.....	.....	3,670	10,200	40,100	15,900	11,900	6,150	4,790	4,070	4,070
18	3,320	.....	.....	3,750	9,420	42,500	15,000	11,200	6,000	4,790	4,070	3,960
19	3,160	.....	.....	3,820	10,500	44,000	14,700	10,400	5,860	4,790	4,070	3,960
20	3,500	.....	.....	3,900	12,100	41,300	14,100	9,860	5,720	4,660	4,070	3,850
21	3,320	.....	.....	3,980	14,600	41,100	13,600	9,300	5,580	4,540	4,540	3,850
22	3,410	.....	.....	4,060	16,400	38,800	13,200	8,760	6,750	4,540	5,310	4,070
23	3,410	.....	.....	4,360	19,800	38,000	12,500	8,760	5,310	4,540	8,050	3,960
24	3,160	.....	.....	4,670	17,800	37,400	13,200	8,940	5,310	4,420	7,380	3,960
25	.....	.....	.....	5,980	19,200	36,900	12,800	8,580	5,310	4,300	6,750	4,070

Daily discharge, in second-feet, of South Fork of Snake River near Lyon, Idaho, for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	.....	.....	.....	6,220	21,800	38,000	12,300	8,050	5,310	4,300	5,580	4,070
27	.....	.....	.....	7,140	26,000	38,000	13,200	7,540	5,050	4,180	4,790	4,070
28	.....	.....	.....	7,850	27,100	38,800	13,200	7,220	4,790	4,180	4,790	4,070
29	.....	.....	2,720	7,000	26,000	39,900	12,800	7,220	4,540	4,180	4,660	4,070
30	.....	.....	2,780	6,220	24,400	39,900	12,300	6,900	4,070	4,180	4,660	4,070
31	.....	.....	2,780	.....	22,800	.....	11,900	6,750	.....	4,070	.....	4,070

NOTE.—Discharge of Jan. 1–7 estimated as equivalent to 2,300 second-feet; and of Jan. 25–31 as 3,100 second-feet. Discharges for Apr. 17–21 and June 7–12 interpolated. Daily discharges are based on rating curves applicable as follows, except as noted above: Jan. 1 to June 19, well defined between 2,340 and 26,000 second-feet; June 20 to Dec. 31, well defined between 3,850 and 20,000 second-feet.

Monthly discharge of South Fork of Snake River near Lyon, Idaho, for 1909.

[Drainage area, 5,480 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage.	Total in acre-feet.	
January	3,500	.....	2,890	0.528	0.61	178,000	D.
February	.....	.....	[a] 3,080	.562	.59	171,000	D.
March	.....	.....	[a] 2,890	.528	.61	178,000	D.
April	7,850	2,860	4,210	.768	.86	251,000	B.
May	27,100	5,750	14,200	2.59	2.99	873,000	A.
June	44,000	25,400	38,300	6.99	7.80	2,280,000	A.
July	38,800	11,900	21,700	3.96	4.56	1,330,000	A.
August	16,800	6,750	11,900	2.17	2.50	732,000	A.
September	7,880	4,070	6.320	1.15	1.28	376,000	A.
October	4,920	3,960	4,420	.807	.93	272,000	A.
November	8,050	3,850	4,550	.830	.93	271,000	A.
December	4,660	3,850	4,110	.750	.86	253,000	B.
The year	44,000	.....	9,880	1.80	24.52	7,160,000	

[a] Mean discharge estimated as 45 per cent of discharge at Neeley Station.

SNAKE RIVER AT NEELEY, IDAHO.

This station, which was established March 17, 1906, is located one-half mile north of Neeley post office, Idaho, 4 miles west of American Falls, the nearest railway point, and about 32 miles above the Minidoka dam.

The principal tributaries above this station are Blackfoot and Port Neuf rivers. Raft River enters the Snake between Neeley and the Minidoka dam.

A large amount of water is diverted above this station by canals in the Idaho Falls irrigation district. During years of low precipitation Snake River is dry at Blackfoot, but a flow of about 2,000 second-feet is formed at Neeley by the water from the Blackfoot and Port Neuf rivers and from springs in the river channel between Blackfoot and Neeley.

A slight shifting of channel was observed after the high water of 1909. The gage datum has remained unchanged since the station was established.

The rating curve is well defined, and the records may be considered good.

Discharge measurements of Snake River at Neeley, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 17	La Rue and O'Neill	511	3,570	5.44	6,740
17	do	511	3,570	5.44	6,520
29	W. M. O'Neill	512	4,370	6.93	11,900
May 7	do	522	4,730	7.72	15,200
14	do	523	5,060	7.95	16,800
June 16	do	526	6,350	10.66	27,900
16	do	526	6,480	10.66	29,200
19	do	516	6,510	11.28	33,200
23	do	529	7,390	12.30	40,100
July 28	do	512	4,130	6.54	10,100
30	do	511	4,550	6.83	11,400
Aug. 1	do	512	4,210	6.22	9,160
2-3	do	510	3,940	6.03	8,590
3	do	510	3,860	5.98	8,160
6	do	513	4,250	6.72	10,900
7	do	512	4,190	6.64	10,500
8	do	512	4,190	6.60	10,300
9	do	512	4,200	6.62	10,400
11	do	512	4,140	6.50	9,910
13	do	512	4,200	6.64	10,900
14	do	512	4,190	6.63	10,500
14	do	512	4,190	6.58	10,400
15	do	512	4,200	6.58	10,300
17	do	512	4,140	6.52	9,750
18	do	512	4,090	6.44	9,800
19	do	512	4,020	6.34	9,440
21	do	510	3,940	6.11	8,780
22	do	510	3,870	6.02	8,460
23	do	511	3,890	6.04	8,330
24	do	510	3,850	5.98	8,170
25	do	510	3,880	6.03	8,260
26	do	510	3,930	6.08	8,190
27	do	510	3,940	6.09	7,940
28	do	510	3,810	5.94	7,700
29	do	510	3,830	5.92	7,530
Sept. 1	do	510	3,780	5.84	7,600
Oct. 21	do	511	3,830	5.94	8,190

Daily gage height, in feet, of Snake River at Neeley, Idaho, for 1909.

[Miss Consuella Hunt, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.0	.....	5.5	5.3	7.0	10.5	11.7	6.4	5.85	5.9	5.95	6.6
2	5.0	5.4	5.5	5.3	6.9	10.3	11.8	6.15	5.85	5.9	6.0	6.5
3	5.0	5.4	5.6	5.3	6.7	10.3	11.8	6.05	5.6	5.9	5.95	6.4
4	5.0	5.4	5.6	5.4	6.6	10.6	11.8	6.25	6.05	5.9	5.95	6.2
5	5.1	5.3	5.6	5.6	6.8	11.0	11.8	6.7	6.25	5.9	6.0	.....
6	5.3	5.3	5.6	5.6	7.1	11.3	11.8	6.7	6.25	5.9	6.0	.....
7	5.4	5.4	5.6	5.6	7.6	11.7	11.8	6.7	6.3	5.95	5.95	.....
8	5.5	5.4	5.6	5.6	7.6	12.0	11.4	6.6	6.5	5.95	5.95	.....
9	5.6	5.5	5.5	5.5	7.7	12.3	11.0	6.6	6.6	5.9	5.95	.....
10	5.3	5.4	5.5	5.5	7.9	12.4	10.0	6.6	6.75	5.95	6.0	.....
11	5.4	5.5	5.5	5.4	8.0	12.5	9.5	6.5	6.6	6.0	6.0	.....
12	5.5	5.6	5.4	5.4	8.1	12.3	9.0	6.55	6.55	6.0	6.0	.....
13	5.6	5.6	5.3	5.6	8.1	11.3	8.7	6.55	6.5	6.05	6.0	.....
14	5.7	5.7	5.3	5.6	8.0	10.0	8.4	6.55	6.6	6.1	6.0	.....
15	5.3	5.7	5.4	5.6	7.9	10.7	8.2	6.7	6.7	6.1	5.95	.....
16	5.8	5.8	5.4	5.5	7.7	10.8	7.9	6.75	6.6	6.1	5.95	.....
17	5.9	6.0	5.4	5.5	7.9	10.9	7.8	6.6	6.55	6.05	5.95	.....
18	6.0	5.9	5.4	5.6	8.0	11.0	7.6	6.45	6.4	6.0	5.95	.....
19	6.1	5.8	5.4	5.7	7.9	11.3	7.5	6.35	6.35	6.0	6.0	.....
20	6.2	5.7	5.3	5.9	7.6	11.6	7.4	6.3	6.3	6.0	6.0	.....
21	6.3	5.7	5.3	6.2	7.7	11.8	7.2	6.3	6.3	5.95	6.1	.....
22	6.3	5.6	5.3	6.3	7.8	12.0	7.1	6.25	6.3	5.95	6.3	.....
23	6.2	5.5	5.3	6.2	8.0	12.3	7.0	6.25	6.2	5.95	6.4	.....
24	5.9	5.5	5.3	6.2	8.6	12.3	6.9	6.0	6.2	5.95	6.75	.....
25	5.8	5.5	5.3	6.2	8.9	12.3	6.8	6.0	6.2	5.9	7.0	.....
26	5.7	5.5	5.3	6.3	9.1	12.2	6.7	6.05	6.15	5.9	7.25	.....
27	5.5	5.5	5.3	6.3	9.4	12.0	6.6	6.05	6.1	5.85	7.0	.....
28	5.4	5.5	5.3	6.6	9.8	11.8	6.5	6.0	6.1	5.85	7.0	.....
29	5.4	.....	5.3	7.0	10.1	11.7	6.5	5.95	6.7	5.85	6.9	.....
30	.....	.....	5.4	7.1	10.4	11.6	6.6	5.95	6.3	5.9	6.8	.....
31	.....	.....	5.4	.....	10.7	.....	6.7	5.85	.....	5.9	.....	.....

NOTE.—River frozen at gage Dec. 5-31. Gage not read Jan. 30, 31, and Feb. 1.

Daily discharge, in second-feet, of Snake River at Neeley, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5,280	a6,380	6,680	6,090	12,100	29,900	36,600	9,720	7,780	7,940	8,110	10,500
2	5,280	6,380	6,680	6,090	11,700	28,800	37,200	8,810	7,780	7,940	8,280	10,100
3	5,280	6,380	6,980	6,090	10,900	28,800	37,200	8,460	6,980	7,940	8,110	9,720
4	5,280	6,380	6,980	6,380	10,500	30,500	37,200	9,170	8,460	7,940	8,110	8,990
5	5,540	6,090	6,980	6,980	11,300	32,700	37,200	10,900	9,170	7,940	8,280	.....
6	6,090	6,090	6,980	6,980	12,500	34,400	37,200	10,900	9,170	7,940	8,280	.....
7	6,380	6,380	6,980	6,980	14,800	36,600	37,200	10,900	9,350	8,110	8,110	.....
8	6,680	6,380	6,980	6,980	14,800	38,300	34,900	10,500	10,100	8,110	8,110	.....
9	6,980	6,680	6,680	6,680	15,200	40,000	32,700	10,500	10,500	7,940	8,110	.....
10	6,090	6,380	6,680	6,680	16,200	40,500	27,100	10,500	11,100	8,110	8,280	.....
11	6,380	6,680	6,680	6,380	16,700	41,100	24,400	10,100	10,500	8,280	8,280	.....
12	6,680	6,980	6,380	6,380	17,200	40,000	21,800	10,300	10,300	8,280	8,280	.....
13	6,980	6,980	6,090	6,980	17,200	34,400	20,200	10,300	10,100	8,460	8,280	.....
14	7,290	7,290	6,090	6,980	16,700	27,100	18,700	10,300	10,500	8,630	8,280	.....
15	6,090	7,290	6,380	6,980	16,200	31,000	17,700	10,900	10,900	8,630	8,110	.....
16	7,610	7,610	6,380	6,680	15,200	31,600	16,200	11,100	10,500	8,630	8,110	.....
17	7,940	8,280	6,380	6,680	16,200	32,100	15,700	10,500	10,300	8,460	8,110	.....
18	8,280	7,940	6,380	6,980	16,700	32,700	14,800	9,910	9,720	8,280	8,110	.....
19	8,630	7,610	6,380	7,290	16,200	34,400	14,300	9,540	9,540	8,280	8,280	.....
20	8,990	7,290	6,090	7,940	14,800	36,100	13,800	9,350	9,350	8,280	8,280	.....
21	9,350	7,290	6,090	8,990	15,200	37,200	13,000	9,350	9,350	8,110	8,630	.....
22	9,350	6,980	6,090	9,350	15,700	38,300	12,500	9,170	9,350	8,110	9,350	.....
23	8,990	6,680	6,090	8,990	16,700	40,000	12,100	9,170	8,990	8,110	9,720	.....
24	7,940	6,680	6,090	8,990	19,700	40,000	11,700	8,280	8,990	8,110	11,100	.....
25	7,610	6,680	6,090	8,990	21,300	40,000	11,300	8,280	8,990	7,940	12,100	.....
26	7,290	6,680	6,090	9,350	22,300	39,400	10,900	8,460	8,810	7,940	13,200	.....
27	6,680	6,680	6,090	9,350	23,900	38,300	10,500	8,460	8,630	7,780	12,100	.....
28	6,380	6,680	6,090	10,500	26,000	37,200	10,100	8,280	8,630	7,780	12,100	.....
29	6,380	.....	6,090	12,100	27,700	36,600	10,100	8,110	10,900	7,780	11,700	.....
30	a6,380	.....	6,380	12,500	29,300	36,100	10,500	8,110	9,350	7,940	11,300	.....
31	a6,380	.....	6,380	.....	31,000	.....	10,900	7,780	.....	7,940	.....	.....

a Discharge interpolated.

NOTE.—These discharges are based on a rating curve that is well defined.

Monthly discharge of Snake River at Neeley, Idaho, for 1909.

Months.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	9,350	5,280	6,980	429,000	B.
February	8,280	6,090	6,850	380,000	B.
March	6,980	6,090	6,430	395,000	A.
April	12,500	6,090	7,810	465,000	A.
May	31,000	10,500	17,500	1,080,000	A.
June	41,100	27,100	35,500	2,110,000	A.
July	37,200	10,100	21,200	1,300,000	A.
August	11,100	7,780	9,550	587,000	A.
September	11,100	6,980	9,470	564,000	A.
October	8,630	7,780	8,120	499,000	A.
November	13,200	8,110	9,170	546,000	A.
December	.....	.....	a 8,500	523,000	B.
The year	41,100	5,280	12,300	8,880,000	

a Mean estimated on basis of comparisons with other stations in Snake River basin.

SNAKE RIVER NEAR MINIDOKA, IDAHO.

The station, which is located at Montgomery's Ferry, on the stage road from Minidoka to Albion, was established August 3, 1895, and has been maintained continuously since that time, except during the year 1900. The station is 6 miles due east of Rupert, Idaho, 10

miles below the Minidoka dam, and 23 miles above the diversion dam of the Twin Falls canals at Milner. Measurements at Montgomery's Ferry indicate the amount of water available for the Twin Falls canals, but some seepage water is returned to the river from the Minidoka tract below the station.

Raft River is the only important tributary entering Snake River between this station and that at Neeley, 44 miles above. No important tributaries enter below the station for a distance of 40 miles.

In dry years the discharge at this station falls below 2,000 second-feet during the latter part of July and August. As the water rights of the Twin Falls canals call for an amount considerably in excess of this, the deficiency has to be supplied by stored water from Jackson Lake, Wyo.

The records are somewhat affected by ice during the winter months and by backwater from the Milner dam, but they may be considered as fairly good. Some irregularity of flow is caused by the opening and closing of the gates at the Minidoka dam. (See Pl. VI, *A*, p. 250.)

The gage datum has remained unchanged since August 28, 1905.

Discharge measurements of Snake River near Minidoka, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	W. M. O'Neill	863	6,480	6.23	14,700
June 17	do	884	9,610	9.72	28,100
21	do	884	10,800	11.04	34,000
22	do	884	11,000	11.36	34,900
Aug. 1	H. L. Stoner	846	4,850	4.48	8,080
2	do	836	4,650	4.22	7,430
3	do	833	4,560	4.10	7,400
6	do	849	5,040	4.64	8,680
7	do	851	5,170	4.77	9,010
8	do	850	5,140	4.70	8,920
9	do	849	5,020	4.60	8,790
10	do	849	5,010	4.58	8,640
11	do	849	4,950	4.52	8,480
12	do	849	4,940	4.50	8,400
15	do	849	4,940	4.51	8,520
16	do	850	5,030	4.60	8,470
17	do	850	5,020	4.60	8,720
18	do	849	4,940	4.52	8,510
19	do	847	4,840	4.38	8,060
20	do	846	4,690	4.24	7,720
22	do	835	4,440	3.90	6,730
23	do	836	4,600	4.10	7,400
24	do	833	4,510	4.00	7,130
25	do	827	4,300	3.75	6,500
26	do	834	4,400	3.86	6,680
28	do	825	4,250	3.70	6,690
29	do	830	4,190	3.55	6,570
31	do	823	4,080	3.54	5,970
Sept. 1	do	830	4,360	3.80	7,160
2	do	830	4,330	3.76	7,290
3	do	832	4,340	3.80	7,240
4	do	840	4,550	4.05	8,080
7	do	840	4,650	4.15	8,240
8	do	842	4,690	4.20	8,350
9	do	843	4,740	4.25	8,600
10	do	846	4,860	4.40	9,290
13	do	852	5,170	4.75	9,870
14	do	851	4,950	4.50	9,130
15	do	852	5,190	4.80	10,500
Oct. 21	F. F. Henshaw	835	4,590	4.05	7,580
Nov. 24	O'Neill and Hartwell	838	4,770	4.11	8,290

Daily gage height, in feet, of Snake River near Minidoka, Idaho, for 1909.

[Geo. Montgomery, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.1	3.3	3.45	3.3	5.2	9.65	11.1	4.5	3.8	4.0	3.7	4.05
2	3.1	3.3	3.55	3.25	5.15	9.4	11.15	4.2	3.75	3.8	3.6	4.2
3	3.1	3.2	3.55	3.2	4.95	9.2	11.2	4.0	3.8	3.55	3.6	4.3
4	3.1	3.3	3.55	3.3	4.75	9.4	11.25	3.8	4.0	3.5	3.65	4.2
5	3.25	3.4	3.6	3.4	4.9	9.7	11.1	4.25	4.0	3.65	3.8	4.05
6	3.5	3.4	3.6	3.45	5.15	10.25	11.05	4.7	4.1	3.8	4.05	3.9
7	3.6	3.45	3.6	3.6	5.6	10.55	11.2	4.8	4.1	3.9	4.1	3.9
8	3.5	3.5	3.55	3.5	6.05	11.2	11.15	4.65	4.2	3.8	4.15	3.8
9	3.35	3.6	3.6	3.4	5.9	11.6	11.05	4.6	4.3	3.8	4.2	3.85
10	3.6	3.45	3.5	3.3	6.05	11.85	9.9	4.6	4.4	3.7	4.2	4.0
11	3.85	3.4	3.55	3.45	6.2	12.0	8.5	4.55	4.5	3.7	4.15	4.4
12	3.65	3.3	3.5	3.45	6.4	12.0	8.0	4.45	4.6	3.8	4.1	4.3
13	3.5	3.3	3.45	3.2	6.55	11.65	7.5	4.35	4.6	3.8	3.95	4.2
14	3.5	3.7	3.55	3.6	6.4	10.95	7.05	4.4	4.6	3.8	3.9	4.2
15	3.5	3.7	3.3	3.5	6.25	10.2	6.7	4.6	4.9	3.8	3.9	4.35
16	3.5	3.7	3.25	3.3	5.95	9.7	6.35	4.6	4.9	4.05	3.85	4.2
17	3.5	3.75	3.25	3.2	6.15	9.7	5.95	4.6	4.95	4.4	3.85	4.2
18	3.95	4.1	3.35	3.4	5.95	9.9	5.8	4.55	4.95	4.4	3.85	4.45
19	4.15	3.85	3.4	3.35	6.15	10.1	5.8	4.35	4.85	4.25	3.9	4.6
20	4.3	4.15	3.3	3.35	6.15	10.6	5.7	4.2	4.9	4.1	3.9	6.3
21	4.5	3.75	3.55	3.9	5.95	11.0	5.45	4.1	4.9	4.05	3.9	6.4
22	4.6	3.6	3.3	4.1	5.95	11.4	5.25	4.0	4.8	4.05	4.0	6.2
23	4.7	3.6	3.35	3.95	6.3	11.7	5.1	4.0	4.8	4.0	4.1	6.05
24	4.55	3.55	3.2	4.1	6.85	11.9	5.0	3.9	4.8	3.9	4.2	5.85
25	4.3	3.4	3.2	4.15	7.4	11.85	4.9	3.8	4.75	3.9	4.3	5.5
26	3.9	3.4	3.2	4.1	7.75	11.75	4.95	4.0	4.7	3.9	4.45	5.1
27	3.65	3.3	3.15	4.15	7.95	11.6	4.8	3.95	4.2	3.85	4.65	4.8
28	3.45	3.4	3.15	4.2	8.15	11.3	4.7	3.65	4.15	3.8	4.65	4.65
29	3.35	.....	3.35	4.8	8.6	11.15	4.7	3.5	4.2	3.7	4.6	4.45
30	3.4	.....	3.2	5.4	9.25	11.05	4.85	3.45	4.2	3.5	4.35	4.35
31	3.3	.....	3.35	.....	9.6	.....	4.85	3.55	.....	3.5	.....	4.55

NOTE.—Ice conditions and backwater effect Dec. 18 to 31.

Daily discharge, in second-feet, of Snake River near Minidoka, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5,560	6,100	6,500	6,100	11,800	27,800	34,000	8,420	7,160	7,750	6,800	8,200
2	5,560	6,100	6,780	5,960	11,700	26,800	34,200	7,630	7,290	7,200	6,500	8,650
3	5,560	5,830	6,780	5,830	11,000	26,000	34,400	7,120	7,240	6,520	6,720	8,950
4	5,560	6,100	6,780	6,100	10,400	26,800	34,700	6,620	8,080	6,380	6,860	8,650
5	5,960	6,370	6,920	6,370	10,800	28,100	34,000	7,700	8,080	6,800	7,240	8,200
6	6,640	6,370	6,920	6,500	11,400	30,400	33,800	8,990	8,240	7,200	8,000	7,770
7	6,920	6,500	6,920	6,920	12,900	31,600	34,400	9,280	8,240	7,470	8,150	7,770
8	6,640	6,640	6,780	6,640	14,500	34,400	34,200	8,840	8,350	7,020	8,270	7,480
9	6,240	6,920	6,920	6,370	14,000	36,200	33,800	8,700	8,600	7,020	8,420	7,620
10	6,920	6,500	6,640	6,100	14,500	37,200	28,900	8,700	9,290	6,800	8,420	8,000
11	7,620	6,370	6,780	6,500	15,100	37,900	23,100	8,560	9,300	6,800	8,500	9,250
12	7,060	6,100	6,640	6,500	15,800	37,900	21,000	8,280	9,600	7,020	8,350	8,950
13	6,640	6,100	6,500	5,830	16,000	36,400	19,000	8,020	9,360	7,020	7,920	8,650
14	6,640	7,200	6,780	6,920	15,500	33,400	17,300	8,150	9,360	7,020	7,770	8,650
15	6,640	7,200	6,100	6,640	14,900	30,200	15,900	8,700	10,800	7,020	7,770	9,100
16	6,640	7,200	5,960	6,100	13,900	28,100	14,600	8,700	10,800	7,800	7,620	8,650
17	6,640	7,340	5,960	5,830	14,500	28,100	13,100	8,700	11,000	8,800	7,620	8,650
18	7,920	8,350	6,240	6,370	13,900	28,900	12,600	8,560	11,000	8,550	7,620	8,650
19	8,500	7,620	6,370	6,240	14,500	29,700	12,600	8,020	10,700	8,130	7,770	8,650
20	8,950	8,500	6,100	6,240	14,200	31,900	12,200	7,630	10,600	7,750	7,770	8,650
21	9,560	7,340	6,780	7,770	13,500	33,600	11,300	7,370	10,600	7,580	7,770	8,650
22	9,870	6,920	6,100	8,350	13,500	35,300	10,700	7,120	10,300	7,580	8,060	8,650
23	10,200	6,920	6,240	7,920	14,800	36,600	10,200	7,120	10,300	7,460	8,350	8,650
24	9,720	6,780	5,830	8,350	16,900	37,400	9,890	6,870	10,300	7,200	8,650	8,650
25	8,950	6,370	5,830	8,500	19,000	37,200	9,580	6,620	10,200	7,200	8,950	8,650

Daily discharge, in second-feet, of Snake River near Minidoka, Idaho, for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	7,770	6,370	5,830	8,350	20,400	36,800	9,740	7,120	10,000	7,300	9,400	8,650
27	7,060	6,100	5,700	8,500	20,800	36,200	9,280	6,900	8,500	7,200	10,000	8,650
28	6,500	6,370	5,700	8,650	21,600	34,900	8,990	6,690	8,370	7,030	10,000	8,650
29	6,240	.....	6,240	10,500	23,500	34,200	8,990	6,570	8,350	6,800	9,870	8,650
30	6,370	.....	5,830	12,500	26,200	33,800	9,430	6,270	8,350	6,250	9,100	8,650
31	6,100	.....	6,240	.....	27,600	.....	9,430	5,970	.....	6,250	.....	8,650

NOTE.—These discharges are based on rating curves applicable as follows except as noted:
Jan. 1 to Apr. 30 and Nov. 16 to Dec. 31, curve not well defined.
May 1 to May 31 and Sept. 11 to Nov. 15, the indirect method for shifting channels used.
June 1 to Aug. 26, well defined.
Actual measurements were used Aug. 27 to Sept. 10 as mean discharge for the day, the discharge being interpolated between measurements for days when measurements were missing.
Discharge estimated Dec. 18-31.

Monthly discharge of Snake River near Minidoka, Idaho, for 1909.

[Drainage area, 17,900 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	10,200	5,560	7,200	0.402	0.46	443,000	B.
February	8,500	5,830	6,740	.377	.39	374,000	B.
March	6,920	5,700	6,380	.356	.41	392,000	B.
April	12,500	5,830	7,180	.401	.45	427,000	B.
May	27,600	10,400	15,700	.877	1.01	965,000	B.
June	37,900	26,000	32,800	1.83	2.04	1,950,000	A.
July	34,700	8,990	19,500	1.09	1.26	1,200,000	A.
August	9,280	5,970	7,740	.432	.50	476,000	A.
September	11,000	7,160	9,280	.518	.58	552,000	A.
October	8,800	6,250	7,220	.403	.46	444,000	A.
November	10,000	6,500	8,140	.455	.51	484,000	A.
December	9,250	7,480	8,530	.477	.55	524,000	C.
The year	37,900	5,560	11,400	.635	8.62	8,230,000	

NORTH SIDE MINIDOKA CANAL NEAR MINIDOKA, IDAHO.

This station, which was established by the United States Reclamation Service May 1, 1909, is located about 350 feet below the head gates at the Minidoka dam.

The records show the total amount of water diverted from Snake River on the north side at the Minidoka dam. This water is used for irrigation on the Minidoka project of the United States Reclamation Service.

The canal runs through a rock cut in the vicinity of the station, and the velocity is rather high for obtaining the best results.

Discharge measurements of North Side Minidoka canal near Minidoka, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 11	W. M. O'Neill	39	177	5.11	541
25	E. C. La Rue	39	193	5.70	649
Aug. 7	Stoner and Parry	43	319	7.65	1,160
31	Hoyt and La Rue	43	254	6.98	870
Sept. 11	W. M. O'Neill	42	222	6.13	657
11	do	39	186	5.42	526
11	do	40	234	6.65	745
12	do	39	209	5.94	608
Oct. 21	F. F. Henshaw	38	188	5.18	556

Daily gage height, in feet, of North Side Minidoka canal near Minidoka, Idaho, for 1909.

[J. Frank Hogue, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	4.35	5.65	8.4	7.45	6.95	5.7	5.2	16	5.4	7.85	8.0	7.55	7.4	6.2	.....
2	4.35	5.8	8.45	7.45	6.8	5.65	5.3	17	5.4	7.95	8.0	7.55	7.6	5.95	.....
3	4.35	6.0	8.45	7.45	6.45	5.7	5.5	18	5.4	8.1	8.0	7.55	7.5	5.75	.....
4	4.5	6.4	8.45	7.5	7.15	5.85	5.55	19	5.4	8.25	8.0	7.55	7.4	5.5	.....
5	4.75	6.8	8.45	7.65	7.1	5.95	.....	20	5.55	8.5	8.0	7.55	7.25	5.35	.....
6	4.85	6.95	8.4	7.65	6.3	5.95	.....	21	5.6	8.5	8.0	7.55	7.0	5.25	.....
7	4.85	7.15	8.3	7.6	6.1	5.8	.....	22	5.6	8.45	8.05	7.6	6.8	5.2	.....
8	4.9	7.2	8.25	7.6	6.15	5.95	.....	23	5.65	8.35	8.1	6.9	6.65	5.15	.....
9	5.05	7.35	8.15	7.6	6.15	5.95	.....	24	5.65	8.4	8.05	6.5	6.70	5.0	.....
10	5.1	7.45	8.05	7.55	5.9	5.95	.....	25	5.7	8.35	3.3	6.45	6.45	5.0	.....
11	5.15	7.45	7.95	7.55	6.0	6.05	.....	26	5.7	8.45	2.65	6.95	6.1	4.95	.....
12	5.15	7.55	7.95	7.55	6.1	6.1	.....	27	5.85	8.5	7.3	7.05	6.0	4.95	.....
13	5.15	7.55	7.95	7.55	6.05	6.1	.....	28	5.95	8.45	7.2	7.05	5.95	4.9	.....
14	5.2	7.65	7.95	7.55	6.05	6.15	.....	29	5.95	8.4	7.2	6.95	6.0	4.85	.....
15	5.35	7.8	8.0	7.55	6.5	6.25	.....	30	6.0	8.4	7.45	6.95	5.75	4.9	.....
								31	4.8	.....	7.5	6.95	.....	5.1	.....

Daily discharge, in second-feet, of North Side Minidoka canal near Minidoka, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	394	635	1,200	1,000	895	645	548
2	394	665	1,210	1,000	865	635	567
3	394	705	1,210	1,000	795	645	605
4	420	785	1,210	1,010	936	675	615
5	465	865	1,210	1,040	926	695	.....
6	483	895	1,200	1,040	765	695	.....
7	483	936	1,180	1,030	725	665	.....
8	492	947	1,170	1,030	735	695	.....
9	520	978	1,150	1,030	735	695	.....
10	529	1,000	1,130	1,020	685	695	.....
11	538	1,000	1,100	1,020	705	715	.....
12	538	1,020	1,100	1,020	725	725	.....
13	538	1,020	1,100	1,020	715	725	.....
14	548	1,040	1,100	1,020	715	735	.....
15	576	1,070	1,120	1,020	805	755	.....
16	586	1,080	1,120	1,020	989	745	.....
17	586	1,100	1,120	1,020	1,030	695	.....
18	586	1,140	1,120	1,020	1,010	655	.....
19	586	1,170	1,120	1,020	989	605	.....
20	615	1,220	1,120	1,020	958	576	.....
21	625	1,220	1,120	1,020	905	558	.....
22	625	1,210	1,130	1,030	865	548	.....
23	635	1,190	1,140	885	835	538	.....
24	635	1,200	1,130	805	845	510	.....
25	645	1,190	225	795	795	510	.....

Daily discharge, in second-feet, of North Side Minidoka canal near Minidoka, Idaho, for 1909—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
26	645	1,210	138	895	725	501	.....
27	675	1,220	968	916	705	501	.....
28	695	1,210	947	916	695	492	.....
29	695	1,200	947	895	705	483	.....
30	705	1,200	1,000	895	655	492	.....
31	474	.....	1,010	895	.....	529	.....

NOTE.—These discharges are based on a rating table which is fairly well defined by measurements made during 1909 and 1910.

Monthly discharge, in second-feet, of North Side Minidoka canal near Minidoka, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	705	394	559	34,400	A.
June	1,220	635	1,040	61,900	B.
July	1,210	138	1,060	65,200	B.
August	1,040	795	979	60,200	B.
September	1,030	655	814	48,400	B.
October	755	483	624	38,400	B.
The period	.....	.....	.....	308,000	

SOUTH SIDE MINIDOKA CANAL NEAR MINIDOKA, IDAHO.

This station, which was established by the United States Reclamation Service April 21, 1909, is located just below the head gates at the Minidoka dam. Discharge measurements, however, were made by engineers of the Reclamation Service during 1908. The records show the total amount of water diverted from Snake River by the United States Reclamation Service for the irrigation of the South Side Minidoka tract.

The stage of the canal is recorded by an automatic gage about 300 feet from the headworks, and measurements are made from a suspension footbridge located near the gage.

Discharge measurements of South Side Minidoka canal near Minidoka, Idaho, in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 15	United States Reclamation Service engineers	46.5	69.9	1.8	82
June 9	do	46.5	60.1	1.6	60
24	do	46.5	77.9	2.0	87
July 8	do	51.0	108.0	2.6	134
27	do	51.0	114.0	2.7	146
1909.					
May 26	E. C. La Rue	45.0	42.0	1.15	34
Sept. 10	W. M. O'Neill	60.0	192.0	3.85	226

Daily gage height, in feet, of South Side Minidoka canal near Minidoka, Idaho, for 1909.

[J. Frank Hogue, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	1.25	2.15	3.75	3.6	3.45	16	.....	3.35	2.7	3.55	3.55	.....
2	.....	1.25	2.15	3.7	3.6	3.45	17	.....	2.1	2.75	3.55	3.55	.....
3	.....	1.25	2.1	3.65	3.55	3.4	18	.....	1.8	2.75	3.6	3.55	.....
4	.....	1.3	2.15	3.55	3.55	3.4	19	.....	2.05	2.85	3.55	3.55	.....
5	.....	1.6	2.3	3.55	3.6	.....	20	.....	1.7	3.0	3.6	3.55	.....
6	.....	1.45	2.3	3.55	3.6	.....	21	1.3	2.05	3.0	3.6	3.55	.....
7	.....	.....	2.3	3.6	3.6	.....	22	1.3	1.95	3.05	3.6	3.5	.....
8	.....	.....	2.35	3.6	3.6	.....	23	1.35	1.8	3.05	3.6	3.5	.....
9	.....	.....	2.4	3.55	3.6	.....	24	1.35	2.25	3.15	3.6	3.5	.....
10	.....	.....	2.45	3.6	3.6	.....	25	1.3	1.6	3.3	3.6	3.5	.....
11	.....	.....	2.5	3.55	3.6	.....	26	1.35	1.45	3.3	3.65	3.5	.....
12	.....	.....	2.5	3.55	3.6	.....	27	.9	1.95	3.45	3.65	3.55	.....
13	.....	.....	2.5	3.55	3.6	.....	28	.95	2.1	3.5	3.6	3.5	.....
14	.....	.....	2.5	3.55	3.6	.....	29	1.2	2.2	3.4	3.6	3.5	.....
15	.....	3.3	2.6	3.55	3.55	.....	30	1.25	2.6	3.7	3.6	3.5	.....
							31	.....	2.15	.....	3.6	3.55	.....

NOTE.—The automatic gage was out of order May 7 to 14. During this period there was water running in the canal, but no report was given to show whether the flow was uniform or not.

Daily discharge, in second-feet, of South Side Minidoka canal near Minidoka, Idaho, for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Day.	Apr.	May.	June.	July.	Aug.	Sept.
1	.....	40	98	243	228	213	16	.....	203	143	223	223	.....
2	.....	40	98	238	228	213	17	.....	94	148	223	223	.....
3	.....	40	94	233	223	208	18	.....	73	148	228	223	.....
4	.....	42	98	223	223	208	19	.....	90	156	223	223	.....
5	.....	60	109	223	228	.....	20	.....	66	170	228	223	.....
6	.....	51	109	223	228	.....	21	42	90	170	228	223	.....
7	.....	.....	109	228	228	.....	22	42	84	174	228	218	.....
8	.....	.....	113	228	228	.....	23	45	73	174	228	218	.....
9	.....	.....	117	223	228	.....	24	45	105	184	228	218	.....
10	.....	.....	121	228	228	.....	25	42	60	198	228	218	.....
11	.....	.....	125	223	228	.....	26	45	51	198	233	218	.....
12	.....	.....	125	223	228	.....	27	22	84	213	233	223	.....
13	.....	.....	125	223	228	.....	28	24	94	218	228	218	.....
14	.....	.....	125	223	228	.....	29	37	101	208	228	218	.....
15	.....	198	134	223	223	.....	30	40	134	238	228	218	.....
							31	.....	98	.....	228	223	.....

NOTE.—These discharges are based on a rating curve well defined between 30 and 200 second-feet.

Monthly discharge of South Side Minidoka canal near Minidoka, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
Apr. 21-30	.....	.....	38.4	762	A.
May (23 days)	.....	.....	85.7	3,910	A.
June	238	94	148	8,810	A.
July	243	223	227	14,000	A.
August	228	218	224	13,800	A.

SNAKE RIVER AT MILNER, IDAHO.

This station, which is located at Milner, Idaho, about 1,000 feet below the diversion dam of the Twin Falls canals, was established May 10, 1909, in cooperation with the Twin Falls Land & Water Co., to determine the amount of water wasting over the Milner dam and available for use for irrigation and power development below. In connection with the records obtained at the stations on the Twin Falls canals, the records show the total amount of water available above the Milner dam.

No important tributaries enter the river between this station and the Minidoka station above and Shoshone Falls below.

Water is diverted above the station by two irrigation canals at the Minidoka dam and two irrrigation canals at the Twin Falls dam in addition to all the water diverted in the Idaho Falls irrigation district. The normal low-water flow in dry years is already appropriated above this point and during the month of August must be supplemented by stored water from Jackson Lake, Wyo.

Measurements are made from a car and cable. The low-water section of the gage is an inclined staff at the cable section. The upper section is a vertical staff located about 15 feet upstream.

The records at this station are not affected by ice. Some irregularity of flow is caused by the opening and shutting of the gates on the Milner dam just above.

The gage datum has remained unchanged since the station was established. Owing to unfavorable conditions for measuring, the records at this station can be considered only fair. A sufficient number of measurements have not yet been obtained to develop a rating curve.

Discharge measurements of Snake River at Milner, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
Aug. 4	La Rue and Stoner	359	4,280	12.20	3,480
13	H. L. Stoner	360	4,530	12.90	5,470
21	do	360	4,370	12.50	4,250
30	do	359	4,340	12.40	5,080
Sept. 6	do	359	4,890	13.90	7,280
12	do	359	5,000	14.20	9,220
Nov. 26	O. W. Hartwell	343	4,620	14.38	6,370

Daily gage height, in feet, of Snake River at Milner, Idaho, for 1909.

[A. J. Seckner, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	18.5	18.7	13.03	14.0	13.75	13.5	14.3
2	.....	18.0	18.8	12.66	13.55	13.25	13.55	14.3
3	.....	17.7	18.8	12.43	.....	12.9	13.55	14.4
4	.....	17.6	19.0	12.17	.....	12.95	13.6	14.1
5	.....	17.8	19.0	12.25	.....	13.0	13.65	14.2
6	.....	18.3	18.7	13.01	.....	14.0	14.1	14.1
7	.....	18.7	18.8	13.16	.....	13.95	14.1	13.9
8	.....	19.0	19.0	13.17	.....	13.9	14.1	13.75
9	.....	19.3	18.9	13.14	.....	13.75	14.1	13.75
10	15.0	19.5	18.0	13.08	.....	13.6	14.1	13.6
11	15.1	20.0	16.65	13.0	.....	13.6	14.1	13.95
12	15.55	20.1	16.5	13.0	.....	13.55	14.05	13.9
13	15.75	20.0	15.8	12.9	.....	13.55	14.0	13.9
14	15.7	19.0	15.5	12.92	.....	13.65	13.9	13.9
15	15.6	18.4	15.3	13.52	.....	13.75	13.75	13.9
16	15.0	17.8	14.8	13.15	.....	13.9	13.8	13.9
17	15.38	17.9	14.7	13.11	.....	14.4	13.7	13.9
18	15.35	17.9	14.25	13.07	.....	14.2	13.75	13.7
19	15.45	18.1	14.38	12.96	.....	14.13	13.8	13.5
20	15.4	18.4	13.9	12.89	.....	14.05	14.0	13.4
21	15.1	19.0	14.1	12.49	.....	14.0	13.9	13.4
22	15.05	19.2	13.9	12.51	14.05	13.95	13.8	13.2
23	15.5	19.4	13.68	12.45	14.05	13.9	13.8	13.1
24	15.6	19.5	13.53	12.53	14.05	13.8	13.9	13.1
25	16.2	19.55	13.4	12.6	14.0	13.75	14.3	13.1
26	16.5	19.5	13.45	12.39	13.65	13.75	14.4	13.2
27	16.6	19.3	13.35	.....	13.4	13.75	14.65	13.2
28	16.6	19.1	13.2	13.9	13.28	13.75	14.6	13.2
29	16.7	18.9	13.15	13.0	13.15	13.55	14.6	13.1
30	17.7	18.7	13.23	12.2	13.25	13.15	14.25	13.1
31	18.0	.....	13.4	12.1	.....	13.45	.....	13.2

NOTE.—Break in Milner dam and all gates raised Aug. 27. All gates raised Sept. 3 to 21.

NORTH SIDE TWIN FALLS CANAL AT MILNER, IDAHO.

This station, which is located at a highway bridge across the canal about one-fourth mile below the head gates at the Milner dam, was established May 10, 1909, to determine the total amount of water diverted by the North Side canal for irrigation in the North Side Twin Falls tract.

The vertical staff gage is on the downstream side of the bridge. Discharge measurements are made from the upstream side.

The records are not affected by ice or by change in control below. The flow is regulated at the head gates on the Milner dam.

The gage datum has not been changed since the station was established.

Discharge measurements of North Side Twin Falls canal at Milner, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	La Rue and O'Neill	77	335	5.66	800
May 10	W. M. O'Neill	80.5	408	6.56	1,040
June 18	do	80	506	7.87	1,390
21	H. L. Stoner	79.5	526	8.12	1,420
July 24	W. M. O'Neill	79.5	532	8.28	1,450
Aug. 5	La Rue and Stoner	79.5	517	7.96	1,400
13	H. L. Stoner	81	539	8.28	1,510
28	Hoyt and La Rue	65	134	2.85	203
30	Hoyt, La Rue, and Stoner	67	211	4.14	410
30	Hoyt and La Rue	67	220	4.14	408
Sept. 4	H. L. Stoner	56	33	1.15	24.5
6	do	.....	.....	.70	0
11	do	65	137	2.85	191
12	do	66	163	3.25	250

Daily gage height, in feet, of North Side Twin Falls canal at Milner, Idaho, for 1909.

[A. J. Seckner, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	7.5	8.2	8.22	1.9	6.88	16	7.00	7.85	8.32	8.32	.....	.....
2	.....	7.5	8.22	8.12	2.5	6.6	17	7.15	7.75	8.33	8.37	.....	.....
3	.....	7.5	8.25	8.07	.....	6.4	18	7.28	7.88	8.3	8.33	.....	.....
4	.....	7.55	8.23	8.00	1.15	6.7	19	7.5	7.98	8.32	8.31	.....	.....
5	.....	7.55	8.25	8.05	.....	6.9	20	7.5	7.98	8.28	8.3	.....	.....
6	.....	7.55	8.28	8.4	.7	.....	21	7.53	7.9	8.33	8.11	.....	.....
7	.....	7.55	8.35	8.42	.....	.....	22	7.53	8.0	8.3	8.13	6.55	.....
8	.....	7.55	8.35	8.39	.....	.....	23	7.53	8.2	8.35	8.09	6.65	.....
9	.....	7.6	8.33	8.4	.....	.....	24	7.53	8.18	8.3	7.41	6.63	.....
10	6.6	7.65	8.15	8.36	.....	.....	25	7.53	8.2	8.28	7.42	6.8	.....
11	6.6	7.65	8.3	8.34	2.85	.....	26	7.53	8.2	8.3	8.4	6.4	.....
12	6.7	7.7	8.35	8.35	3.25	.....	27	7.5	8.2	8.28	8.15	6.18	.....
13	6.8	7.65	8.3	8.29	.....	.....	28	7.6	8.2	8.2	2.6	6.3	.....
14	6.88	7.65	8.35	8.3	.....	.....	29	7.55	8.2	8.18	3.5	6.65	.....
15	6.92	7.75	8.32	8.39	.....	.....	30	7.55	8.23	8.38	4.5	6.83	.....
							31	7.55	.....	8.45	5.2	.....	.....

NOTE.—Owing to a break in Milner dam, Aug. 27, the observer was unable to make readings during a portion of September.

Daily discharge, in second-feet, of North Side Twin Falls canal at Milner, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1,270	1,460	1,460	85	1,110	16	1,140	1,360	1,490	1,490	.....	0
2	.....	1,270	1,460	1,430	148	1,040	17	1,180	1,340	1,490	1,500	.....	0
3	.....	1,270	1,470	1,420	.....	984	18	1,210	1,370	1,480	1,490	.....	0
4	.....	1,280	1,460	1,400	24	1,060	19	1,270	1,400	1,490	1,490	.....	0
5	.....	1,280	1,470	1,410	.....	1,110	20	1,270	1,400	1,480	1,480	.....	0
6	.....	1,280	1,480	1,510	0	0	21	1,280	1,370	1,490	1,430	.....	0
7	.....	1,280	1,500	1,520	.....	0	22	1,280	1,400	1,480	1,440	1,020	0
8	.....	1,280	1,500	1,510	.....	0	23	1,280	1,460	1,500	1,430	1,050	0
9	.....	1,300	1,490	1,510	.....	0	24	1,280	1,450	1,480	1,250	1,040	0
10	1,040	1,310	1,440	1,500	.....	0	25	1,280	1,460	1,480	1,250	1,090	0
11	1,040	1,310	1,480	1,500	193	0	26	1,280	1,460	1,480	1,510	984	0
12	1,060	1,320	1,500	1,500	254	0	27	1,270	1,460	1,480	1,440	927	0
13	1,090	1,310	1,480	1,480	.....	0	28	1,300	1,460	1,460	160	958	0
14	1,110	1,310	1,500	1,480	.....	0	29	1,280	1,460	1,450	295	1,050	0
15	1,120	1,340	1,490	1,510	.....	0	30	1,280	1,460	1,510	496	1,100	0
							31	1,280	.....	1,530	672	.....	0

NOTE.—These discharges are based on a rating curve that is well defined.

Monthly discharge of North Side Twin Falls canal at Milner, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 10-31	1,300	1,040	1,210	52,800	A.
June	1,460	1,270	1,360	80,900	A.
July	1,530	1,440	1,480	91,000	A.
August	1,520	160	1,320	81,200	A.
October	1,110	0	171	10,500	A.
November	0	0	0	0	
December	0	0	0	0	

NOTE.—Owing to a break in Milner dam, Aug. 27, the observer was unable to make gage readings during a portion of September; therefore the estimate for September is omitted.

SOUTH SIDE TWIN FALLS CANAL AT MILNER, IDAHO.

This station, which is located at a highway bridge crossing the canal at a point near the Oregon Short Line Railroad depot, about one-fourth mile below the canal head gates on the Milner dam, was established May 10, 1909, in order to determine the total amount of water diverted by the South Side canal for irrigation in the South Side Twin Falls tract.

A vertical staff gage is attached to the downstream side of the bridge. Discharge measurements are made from the top of a covered water pipe on the upstream side of the bridge.

The records are not affected by ice or by change in control below. The flow is regulated at the head gates on the Milner dam.

No change has been made in the gage datum since the gage was installed.

Discharge measurements of South Side Twin Falls canal at Milner, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	La Rue and O'Neill	112	364	4.16	658
May 8	W. M. O'Neill	83	517	5.42	1,050
June 1	do	123	648	6.54	1,530
18	do	127	842	8.16	2,300
July 24	do	126	926	8.69	2,620
Aug. 3	La Rue and Stoner	126	907	8.60	2,580
14	H. L. Stoner	126	856	8.20	2,380
21	do	126	835	7.99	2,220
28	Hoyt and La Rue	115	420	4.60	780
30	Hoyt, La Rue, and Stoner	118	567	5.90	1,280
30	Hoyt and La Rue	118	567	5.85	1,290
Sept. 4	H. L. Stoner	112	456	4.87	890
11	do	112	452	4.85	858
12	do	114	498	5.25	1,020
Nov. 26	O. W. Hartwell	106	242	3.15	326
29	do	104	248	3.13	327

Daily gage height, in feet, of South Side Twin Falls canal at Milner, Idaho, for 1909.

[A. J. Seckner, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	6.5	8.35	8.49	5.25	5.3	4.3	3.1
2	.....	6.5	8.35	8.51	5.0	5.23	4.3	3.1
3	.....	6.75	8.35	8.55	.....	5.05	4.3	3.35
4	.....	6.95	8.35	8.53	4.87	5.05	3.73	3.3
5	.....	7.2	8.32	8.56	.....	4.95	3.65	3.45
6	.....	7.2	8.3	8.59	.....	4.9	3.7	3.4
7	.....	7.2	8.45	8.55	.....	4.9	3.7	3.3
8	.....	7.75	8.35	8.44	.....	4.95	3.68	3.3
9	.....	8.2	8.32	8.45	.....	4.95	3.88	3.3
10	5.75	8.05	8.38	8.44	.....	5.0	3.88	3.3
11	5.7	7.85	8.45	8.45	4.85	5.0	3.95	3.35
12	5.7	7.9	8.4	8.29	5.25	5.0	3.95	3.3
13	5.7	7.9	8.4	8.18	.....	5.0	3.9	3.3
14	5.98	7.85	8.58	8.2	.....	4.85	3.88	3.3
15	5.95	7.9	8.53	[a] 3.78	.....	4.85	4.0	3.5
16	5.95	8.05	8.52	8.14	.....	4.65	4.05	3.5
17	5.95	8.05	8.35	8.27	.....	4.65	4.1	3.4
18	6.08	8.15	8.5	8.13	.....	4.6	4.07	3.3
19	6.08	8.15	8.5	8.08	.....	4.55	3.6	3.7
20	6.5	8.35	8.48	8.03	.....	4.35	3.35	3.8
21	5.0	9.00	8.55	7.95	.....	3.3	3.38	4.4
22	4.98	8.25	8.55	7.97	5.85	3.3	3.05	4.7
23	5.3	8.25	8.72	7.81	5.55	3.53	3.05	4.8
24	6.28	8.33	8.7	7.7	5.55	4.1	3.1	4.8
25	6.3	8.3	8.65	7.71	5.8	4.15	3.1	3.9
26	6.3	8.3	8.6	7.66	5.6	4.35	3.1	3.7
27	6.3	8.3	8.6	6.95	5.5	4.35	3.15	3.9
28	6.5	8.3	8.55	5.6	5.5	4.3	3.15	4.0
29	6.5	8.3	8.55	5.8	5.23	4.35	3.1	4.1
30	6.48	8.35	8.65	6.4	5.3	4.3	3.1	4.1
31	6.48	.....	8.5	7.0	.....	4.3	.....	4.2

[a] Head gates closed.

NOTE.—Owing to break in Milner dam, Aug. 27, the observer was unable to make readings during a portion of September.

Daily discharge, in second-feet, of South Side Twin Falls canal at Milner, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,540	2,440	2,500	1,010	1,020	666	320
2	.....	1,540	2,440	2,520	915	999	666	320
3	.....	1,660	2,440	2,540	.....	933	666	384
4	.....	1,750	2,440	2,530	868	933	490	371
5	.....	1,870	2,420	2,540	.....	897	467	412
6	.....	1,870	2,410	2,560	.....	879	481	398
7	.....	1,870	2,480	2,540	.....	879	481	371
8	.....	2,140	2,440	2,480	.....	897	475	371
9	.....	2,360	2,420	2,480	.....	897	534	371
10	1,200	2,280	2,450	2,480	.....	915	534	371
11	1,180	2,180	2,480	2,480	861	915	555	384
12	1,180	2,210	2,460	2,400	1,010	915	555	371
13	1,180	2,210	2,460	2,350	.....	915	540	371
14	1,300	2,180	2,550	2,360	.....	861	534	371
15	1,290	2,210	2,530	504	.....	861	570	425
16	1,290	2,280	2,520	2,330	.....	789	586	425
17	1,290	2,280	2,440	2,400	.....	789	601	398
18	1,350	2,340	2,510	2,320	.....	771	592	371
19	1,350	2,340	2,510	2,300	.....	753	453	481
20	1,540	2,440	2,500	2,280	.....	683	384	510
21	915	2,770	2,540	2,240	.....	371	393	700
22	908	2,380	2,540	2,240	1,240	371	308	807
23	1,020	2,380	2,620	2,160	1,120	433	308	843
24	1,440	2,420	2,610	2,110	1,120	601	320	843
25	1,450	2,410	2,590	2,120	1,220	617	320	540
26	1,450	2,410	2,560	2,090	1,140	683	320	481
27	1,450	2,410	2,560	1,750	1,100	683	332	540
28	1,540	2,410	2,540	1,140	1,100	666	332	570
29	1,540	2,410	2,540	1,220	999	683	320	601
30	1,530	2,440	2,590	1,490	1,020	666	320	601
31	1,530	.....	2,510	1,770	.....	666	.....	633

NOTE.—These discharges are based on a rating curve that is well defined.

Monthly discharge of South Side Twin Falls canal at Milner, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 10-31	1,540	908	1,310	57,200	A.
June	2,770	1,540	2,200	131,000	A.
July	2,620	2,410	2,500	154,000	A.
August	2,560	504	2,170	133,000	A.
October	1,020	371	772	47,500	A.
November	666	308	470	28,000	A.
December	843	320	482	29,600	A.
The period				580,000	

NOTE.—Owing to a break in Milner dam, Aug. 27, the observer was unable to make gage readings during a portion of September; therefore the monthly estimate for September is omitted.

SNAKE RIVER AT KING HILL, IDAHO.

This station, which is located at the suspension foot bridge near the Oregon Short Line Railroad depot in the village of King Hill, Idaho, and below Twin Falls and Shoshone Falls, was established May 13, 1909, in order to determine the total flow of Snake River available for irrigation and power below Big Wood River, including the return water from the Minidoka and Twin Falls irrigation tracts. At present this is the lowest station on Snake River in Idaho.

The river receives only two important tributaries between this station and Milner—Salmon Falls River, which joins the Snake about 30 miles above King Hill, and Big Wood River, which comes in about 20 miles above King Hill. Bruneau River is tributary to the Snake about 40 miles below the station.

The total normal low-water flow of Snake River is diverted above this station for use in the Minidoka and Twin Falls irrigation tracts. During dry years practically the total flow during the irrigating season will be derived from return water from these tracts and the flow of springs in the canyon.

A vertical staff gage is attached to the left pier of the suspension bridge on the downstream side. Discharge measurements are also made from the downstream side of the bridge. The gage datum has remained unchanged since the station was established.

The records are not affected by ice or by artificial control below, but some irregularity of flow is caused by the opening and shutting of the gates on the Milner dam.

Discharge measurements of Snake River at King Hill, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 13	W. M. O'Neill	418	4,130	7.54	19,900
June 20	do	433	5,590	11.17	34,100
Sept. 20	do	392	3,110	5.35	11,600
Oct. 1	do	389	3,060	5.09	10,700
Nov. 4	O'Neill and Hartwell	388	3,090	5.25	11,600
23	O. W. Hartwell	413	3,700	6.55	16,100

Daily gage height, in feet, of Snake River at King Hill, Idaho, for 1909.

[Horace Bruce, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	10.95	11.8	4.5	5.0	5.2	5.2	6.1
2	.....	10.85	11.8	4.2	6.0	5.2	5.15	5.8
3	.....	10.55	11.8	4.2	5.75	5.0	5.25	5.6
4	.....	10.4	11.9	4.1	5.4	5.0	5.4	6.1
5	.....	10.6	12.0	4.2	5.3	4.2	5.4	5.8
6	.....	10.9	11.9	4.2	5.4	5.0	5.5	5.8
7	.....	11.0	11.8	4.55	5.4	5.1	5.6	5.9
8	.....	11.6	11.7	4.75	5.45	5.5	5.65	5.8
9	.....	12.0	11.7	4.8	5.55	6.0	5.75	5.65
10	.....	12.65	11.65	4.8	5.55	6.0	5.75	5.6
11	.....	12.9	10.0	4.8	6.45	.....	5.7	5.4
12	.....	13.1	8.75	4.75	6.0	.....	5.65	5.55
13	7.5	13.1	8.1	4.7	6.0	.....	5.5	5.7
14	7.6	12.5	7.6	4.65	5.45	.....	5.45	5.8
15	7.65	11.7	7.0	4.7	6.0	.....	5.4	5.85
16	7.3	11.5	6.7	4.8	6.0	.....	5.4	5.7
17	6.8	11.25	6.5	4.75	6.4	.....	5.4	5.6
18	6.7	11.0	6.3	4.6	6.2	.....	5.45	5.2
19	6.95	10.8	6.0	4.55	6.0	.....	5.6	5.2
20	7.25	11.25	5.9	4.5	5.25	.....	5.7	4.85
21	6.9	11.8	5.55	4.5	5.25	.....	5.85	4.75
22	6.8	12.0	5.4	4.4	5.1	.....	6.5	4.65
23	7.0	12.55	5.3	4.2	5.1	.....	5.5	4.65
24	7.2	12.7	5.2	4.1	5.5	.....	6.0	4.7
25	7.75	12.9	5.1	4.0	5.9	.....	6.1	4.75
26	8.3	12.7	5.0	3.8	6.0	.....	6.2	4.75
27	9.0	12.6	4.95	[a] 7.85	6.0	5.25	6.4	4.8
28	9.0	12.3	4.9	6.4	6.0	5.4	6.5	4.8
29	9.2	12.15	4.8	5.0	6.1	5.4	6.5	4.7
30	9.75	12.0	4.7	5.0	6.1	5.3	6.3	4.75
31	10.4	.....	4.75	5.0	.....	5.25	.....	4.7

[a] Rise due to opening gates at Milner dam.

Daily discharge, in second-feet, of Snake River at King Hill, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	33,300	36,700	8,900	10,500	11,200	11,200	14,400
2	.....	39,900	36,700	7,940	14,000	11,200	11,000	13,300
3	.....	31,700	36,700	7,940	13,100	10,500	11,300	12,600
4	.....	31,100	37,100	7,620	11,800	10,500	11,800	14,400
5	.....	31,900	37,500	7,940	11,500	7,940	11,800	13,300
6	.....	33,100	37,100	7,940	11,800	10,500	12,200	13,300
7	.....	33,500	36,700	9,060	11,800	10,800	12,600	13,600
8	.....	35,900	36,300	9,700	12,000	12,200	12,700	13,300
9	.....	37,500	36,300	9,860	12,400	14,000	13,100	12,700
10	.....	40,100	36,100	9,860	12,400	14,000	13,100	12,600
11	.....	41,100	29,500	9,860	15,600	14,100	12,900	11,800
12	.....	41,900	24,500	9,700	14,000	14,200	12,700	12,400
13	19,600	41,900	21,900	9,540	14,000	14,300	12,200	12,900
14	20,000	39,500	20,000	9,380	12,000	14,400	12,000	13,300
15	20,200	36,300	17,700	9,540	14,000	14,500	11,800	13,500
16	18,800	35,500	16,600	9,860	14,000	14,600	11,800	12,900
17	16,900	34,500	15,800	9,700	15,400	14,700	11,800	12,600
18	16,600	33,500	15,100	9,220	14,700	14,600	12,000	11,200
19	17,500	32,700	14,000	9,060	14,000	14,400	12,600	11,200
20	18,600	34,500	13,600	8,900	11,300	14,300	12,900	10,000
21	17,300	36,700	12,400	8,900	11,300	14,100	13,500	9,700
22	16,900	37,500	11,800	8,580	10,800	14,000	15,800	9,380
23	17,700	39,700	11,500	7,940	10,800	13,800	12,200	9,380
24	18,500	40,300	11,200	7,620	12,200	13,700	14,000	9,540
25	20,600	41,100	10,800	7,300	13,600	13,600	14,400	9,700
26	22,700	40,300	10,500	6,690	14,000	13,400	14,700	9,700
27	25,500	39,900	10,300	20,900	14,000	11,300	15,400	9,860
28	25,500	38,700	10,200	15,400	14,000	11,800	15,800	9,860
29	26,300	38,100	9,860	10,500	14,400	11,800	15,800	9,540
30	28,500	37,500	9,540	10,500	14,400	11,500	15,100	9,700
31	31,100	.....	9,700	10,500	.....	11,300	.....	9,540

NOTE.—These discharges are based on a rating curve well defined between 10,500 and 37,500 second-feet. Discharges Oct. 11 to 26 estimated by comparison with record at Milner.

Monthly discharge of Snake River at King Hill, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 13-31	31,100	16,600	21,000	791,000	A.
June	41,900	31,100	36,700	2,180,000	A.
July	37,500	9,540	21,700	1,330,000	A.
August	20,900	6,690	9,560	588,000	B.
September	15,600	10,500	13,000	774,000	A.
October	14,700	7,940	12,800	787,000	B.
November	15,800	11,000	13,000	774,000	A.
December	14,400	9,380	11,700	719,000	A.
The period				7,940,000	

SNAKE RIVER AT BURBANK, WASH.

This station was established October 2, 1907, by the Burbank Power & Water Co., which has undertaken to reclaim several thousand acres near Burbank by pumping water from Snake River. Power is developed by a plant utilizing the fall in Fivemile Rapids.

Two gages are maintained—No. 1, on the right bank, 1,500 feet upstream from the intake of the power canal; No. 2, on the left bank, at the tailrace of the power plant, 9,200 feet below the upper gage. Both gages are graduated in feet and tenths and read from sea level. In the published gage-height tables, however, the gage datum has been taken as 300 feet above sea level.

Measurements are made from the upstream side of the Northern Pacific Railway (Pendleton branch) bridge about 3 miles below the power house, 3½ miles east of Pasco, one-half mile west of Burbank, Wash., one-fourth mile above the mouth of the river, and 3½ miles below the foot of Fivemile Rapids.

The channel at the measuring section is straight above and below the station. The water is swift at all stages of the stream and will probably be confined within the section limited by the abutments to the railroad bridge. Gage reading to 28 feet is attached to the upstream side of the draw span, but as this gage is affected by backwater from Columbia River, the heights thereon will not accurately indicate the discharge. The conditions at the upper gage are favorable for good results. The observed gage heights are not affected by backwater from Columbia River and will probably be a stable index of the discharge, if suitable corrections can be made for artificial control of water at the head gates.

The construction of a wing dam at the head of the power canal in August, 1909, had the effect of raising the water at the upper gage an unknown amount. The gage at the tailrace was not installed until after the wing dam was completed. It will therefore be impossible to determine the exact effect caused by this wing dam, although

it is probable that some measure of it can be obtained by comparing the records with those observed at Riparia on the Weather Bureau gage.

Gage heights at the tailrace are not yet available for publication. As these are necessary in the preparation of estimates of discharge and also as an insufficient number of discharge measurements have been made, no attempt has been made to compute daily and monthly discharges.

The following discharge measurement was made October 19, 1909, by G. L. Parker:

Width, 700 feet; area, 11,400 square feet; gage height, 336.6 feet; discharge, 26,800 second-feet. Area computed from standard cross section made December 24, 1909. Gage height refers to mean sea-level datum.

Daily gage height, in feet, of Snake River at Burbank, Wash., for 1907–9.

1907	Oct.	Nov.	Dec.	1907	Oct.	Nov.	Dec.	1907	Oct.	Nov.	Dec.
1		35.1	35.1	11	35.0			21	35.0		34.7
2	34.9	35.1		12	35.1			22	35.0		
3	34.9	35.1		13	34.9			23	35.0		
4	34.8			14	34.9			24	35.0	35.0	
5	34.8			15				25	35.0		
6	34.8			16	34.9		35.3	26	35.0		
7	34.8			17				27	35.0		
8	34.8		35.0	18				28		35.4	
9	34.8			19				29			
10	35.0		35.3	20				30	35.1		
								31			

1908	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1							41.2		34.7	34.7	35.7	35.5
2									34.7	34.7	36.1	35.5
3								35.1	34.6		36.1	
4					41.3				34.6		36.0	
5					40.8					34.7	35.9	
6			35.4		40.6				34.5		35.8	
7					40.7	42.9		34.8			35.8	
8						42.7	39.8	34.8	34.4		35.8	
9								34.7			35.8	
10				36.4	41.7	43.5	39.3	34.6			35.8	
11	35.1				41.2	43.8		34.6	34.7		35.8	
12					40.7	44.1	38.7	34.5	34.7		35.6	
13				38.6	40.3	44.4		34.5	34.5		35.6	
14				40.2	40.1	44.4	38.2	34.5	34.5		35.3	
15				39.9	39.9	44.5		34.4			35.3	
16			41.5	39.9	39.9	44.7	37.9	34.4			35.3	
17			43.2	41.6		44.9	38.0	34.5			35.3	
18				41.2	39.7			34.4	34.5		35.3	35.2
19			40.4	40.9		43.8		34.4	34.8		35.3	34.9
20			39.6		39.5	43.5	37.9	34.5	34.8		35.6	34.6
21				42.0	39.5	42.8		34.5	34.9		35.6	34.4
22				42.2	39.4	42.6	37.0	34.4	34.8		35.7	34.5
23					39.4	42.4		34.4			35.9	34.8
24				43.7	39.2	41.8	36.5	34.3	34.7		35.9	34.8
25					39.4	41.5	36.4	34.3			35.9	35.1
26				42.4	40.2	41.9	36.3	34.4		35.6	35.9	35.2
27					40.1	42.2	36.1	34.6	34.5	35.6	35.9	35.3
28					39.8	41.9	35.9	34.6	34.5	35.7	35.7	35.3
29				40.4	40.2	41.7		34.6	34.5	35.7	35.7	35.2
30						41.2		34.6		35.7	35.5	34.9
31					39.8		35.4	34.6				34.9

Daily gage height, in feet, of Snake River at Burbank, Wash., for 1907–9—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	35.1	37.6	37.0	39.3	41.2	.....	44.2	37.9	35.7	37.0	36.7	39.8
2	35.1	37.3	38.7	39.5	40.3	.....	44.2	37.6	36.4	37.0	36.7	39.7
3	35.2	37.1	37.3	39.6	40.7	.....	43.9	37.4	36.4	36.9	36.9	39.4
4	35.3	37.1	37.0	39.5	41.9	50.9	43.6	37.2	36.2	36.9	38.2	38.7
5	36.0	36.6	37.7	39.4	42.8	51.5	43.4	37.1	36.4	36.7	38.1	38.7
6	.....	36.6	37.8	39.2	43.3	51.6	43.2	37.1	36.6	36.7	37.9	38.4
7	.....	36.6	37.7	39.0	42.2	50.0	43.1	36.9	36.9	36.8	37.8	38.1
8	.....	36.5	37.7	38.7	41.8	49.2	42.8	36.8	36.6	36.9	37.7	38.1
9	.....	36.5	37.6	38.6	.....	46.8	42.3	36.5	36.6	37.0	37.5	38.2
10	.....	36.2	37.5	38.7	.....	.....	41.9	36.4	36.6	36.9	37.4	38.3
11	.....	36.2	37.4	38.7	.....	.....	41.5	36.3	36.7	37.0	37.5	38.4
12	.....	36.2	37.3	38.8	.....	46.2	41.6	36.4	36.6	37.0	37.6	38.5
13	.....	36.1	37.1	39.0	.....	.....	41.8	36.6	36.8	36.9	37.5	38.4
14	.....	36.0	37.0	39.2	.....	45.9	41.3	36.5	36.9	36.8	37.5	38.4
15	35.1	36.0	37.0	39.2	41.2	46.2	40.7	36.4	36.9	36.8	37.4	38.2
16	35.3	37.2	37.2	39.6	41.5	46.6	40.1	36.4	36.9	36.8	37.2	38.0
17	35.5	37.1	37.4	39.8	41.8	.....	39.75	36.3	36.7	36.8	37.0	38.1
18	43.7	38.6	37.7	40.0	42.2	48.1	39.4	36.2	36.8	36.6	37.0	37.9
19	42.6	39.2	37.9	40.1	42.1	47.5	39.1	36.2	36.7	36.6	37.1	37.8
20	42.0	39.2	38.0	40.3	.....	47.4	38.8	36.1	36.6	36.5	37.5	37.8
21	43.1	38.7	38.1	40.2	.....	46.6	38.5	36.2	36.6	36.6	39.0	37.5
22	42.2	38.3	37.9	.....	.....	46.0	38.0	36.1	36.7	36.8	38.5	37.3
23	43.1	37.9	37.8	.....	.....	45.5	37.8	36.0	36.8	36.9	38.6	.....
24	43.1	37.5	37.8	.....	.....	45.1	37.8	36.0	36.8	36.8	40.2	37.0
25	41.0	37.3	37.8	.....	42.7	44.7	37.7	36.0	36.6	36.8	41.7	36.9
26	39.9	37.2	37.8	.....	43.5	44.3	37.6	36.0	36.7	36.7	42.8	36.5
27	40.1	37.0	38.2	41.8	44.3	44.2	37.6	35.9	36.6	36.7	42.0	.....
28	38.3	.....	38.7	41.9	.....	44.1	37.6	35.9	36.7	36.7	40.9	.....
29	37.5	.....	38.9	42.1	46.7	43.9	37.9	35.8	36.6	36.6	40.2	37.5
30	37.5	.....	.....	41.8	.....	.....	38.7	36.1	36.5	36.6	39.9	37.3
31	38.7	.....	39.2	.....	.....	.....	38.2	35.8	.....	36.7	.....	37.0

NORTH FORK OF SNAKE RIVER BASIN.

NORTH FORK OF SNAKE RIVER NEAR ORA, IDAHO.

The North Fork of Snake River rises in Lake Henry and flows south and southwest to its junction with the South Fork.

The gaging station, which was established August 20, 1902, is located at the North Fork bridge, 2 miles south of Ora, and 10 miles above St. Anthony, Idaho. The records show the total amount of water available for storage at this point. The station was discontinued June 30, 1909.

The principal tributaries above are Robinson Creek and Warm River, both of which enter about 10 miles above Ora. The principal tributaries below are Fall River, which enters about 5 miles below, and Teton River, which enters about 20 miles below. No water is diverted above the station.

The records are not affected by ice or artificial control above.

The gage datum remained unchanged during the maintenance of the station.

The following discharge measurement was made May 21, 1909, by E. S. Fuller:

Width, 202 feet; area, 575 square feet; gage height, 3.3 feet; discharge, 3,000 second-feet.

Daily gage height, in feet, and discharge, in second-feet, of North Fork of Snake River near Ora, Idaho, for 1909.

[Martha J. Fritz, observer.]

Day.	January.		February.		March.		April.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Feet.*	*Sec.-ft.*
1	2.2	1,170	2.2	1,170	2.1	1,070	2.1	1,070	2.7	1,860	3.5	3,500
2	2.2	1,170	2.2	1,170	2.1	1,070	2.2	1,170	2.7	1,860	3.5	3,500
3	2.2	1,170	2.2	1,170	2.1	1,070	2.2	1,170	2.9	2,210	3.5	3,500
4	2.2	1,170	2.2	1,170	2.1	1,070	2.3	1,280	3.2	2,810	3.5	3,500
5	2.2	1,170	2.2	1,170	2.1	1,070	2.3	1,280	3.4	3,260	3.5	3,500
6	2.2	1,170	2.2	1,170	2.1	1,070	2.3	1,280	3.1	2,600	3.4	3,260
7	2.1	1,070	2.2	1,170	2.1	1,070	2.4	1,410	3.1	2,600	3.4	3,260
8	2.1	1,070	2.2	1,170	2.1	1,070	2.4	1,410	3.2	2,810	3.3	3,030
9	2.1	1,070	2.2	1,170	2.1	1,070	2.3	1,280	3.4	3,260	3.3	3,030
10	2.1	1,070	2.2	1,170	2.1	1,070	2.2	1,170	3.6	3,750	3.2	2,810
11	2.1	1,070	2.2	1,170	2.1	1,070	2.2	1,170	3.6	3,750	3.2	2,810
12	2.1	1,070	2.2	1,170	2.1	1,070	2.2	1,170	3.4	3,260	3.2	2,810
13	2.1	1,070	2.2	1,170	2.1	1,070	2.2	1,170	3.2	2,810	3.1	2,600
14	2.2	1,170	2.1	1,070	2.1	1,070	2.2	1,170	3.2	2,810	3.1	2,600
15	2.2	1,170	2.1	1,070	2.1	1,070	2.2	1,170	3.3	3,030	3.1	2,600
16	2.2	1,170	2.2	1,170	2.1	1,070	2.3	1,280	3.3	3,030	3.1	2,600
17	2.2	1,170	2.2	1,170	2.1	1,070	2.4	1,410	3.2	2,810	3.2	2,810
18	2.2	1,170	2.2	1,170	2.1	1,070	2.4	1,410	3.2	2,810	3.1	2,600
19	2.2	1,170	2.2	1,170	2.1	1,070	2.5	1,550	3.2	2,810	3.0	2,400
20	2.2	1,170	2.2	1,170	2.1	1,070	2.5	1,550	3.3	3,030	3.0	2,400
21	2.2	1,170	2.2	1,170	2.1	1,070	2.5	1,550	3.3	3,030	3.0	2,400
22	2.2	1,170	2.2	1,170	2.1	1,070	2.6	1,700	3.3	3,030	3.0	2,400
23	2.2	1,170	2.2	1,170	2.1	1,070	2.6	1,700	3.6	3,750	3.0	2,400
24	2.2	1,170	2.2	1,170	2.1	1,070	2.6	1,700	3.6	3,750	2.9	2,210
25	2.2	1,170	2.1	1,070	2.1	1,070	2.6	1,700	3.6	1,750	2.9	2,210
26	2.2	1,170	2.1	1,070	2.1	1,070	2.7	1,860	3.6	3,750	2.9	2,210
27	2.2	1,170	2.1	1,070	2.1	1,070	2.8	2,030	3.6	3,750	2.8	2,030
28	2.2	1,170	2.1	1,070	2.1	1,070	3.0	2,400	3.7	4,000	2.8	2,030
29	2.1	1,070	.....	.....	2.1	1,070	2.9	2,210	3.8	4,250	2.8	2,030
30	2.2	1,170	.....	.....	2.1	1,070	2.7	1,860	3.6	3,750	2.7	1,860
31	2.2	1,170	.....	.....	2.1	1,070	.....	.....	3.4	3,260	.....	.....

NOTE.—Daily discharges are based on a rating curve that is well defined.

Monthly discharge of North Fork of Snake River near Ora, Idaho, for 1909.

[Drainage area, 1,040 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	1,170	1,070	1,140	1.10	1.27	70,100	A.
February	1,170	1,070	1,150	1.11	1.16	63,900	A.
March	1,070	1,070	1,070	1.03	1.19	65,800	A.
April	2,400	1,070	1,480	1.42	1.58	88,100	A.
May	4,250	1,860	3,140	3.02	3.48	193,000	A.
June	3,500	1,860	2,700	2.60	2.90	161,000	A.
The period	.....	.....	.....	.....	.....	642,000	

NORTH FORK OF SNAKE RIVER NEAR REXBURG, IDAHO.

This station, which is located just below the highway bridge 7 miles due west of Rexburg, Idaho, was established April 13, 1909, to determine the total amount of water available from the North Fork of Snake River.

It is below all tributaries and diversions. The principal tributaries above are Robinson Creek and Warm, Fall, and Teton rivers, the Teton entering about 1 mile above the station.

The vertical staff gage is located on the right bank about 250 feet downstream from the highway bridge. Discharge measurements are made by means of a car and cable about three-fourths of a mile downstream from the highway bridge.

The gage heights are affected by ice during the winter months.

The gage datum has remained unchanged since the station was established. The bed of the stream at the gaging section is somewhat shifting, but fairly good records may be obtained by making frequent discharge measurements.

Discharge measurements of North Fork of Snake River near Rexburg, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 22	W. M. O'Neill	284	1,810	5.80	4,620
June 14	do	289	1,940	6.44	4,520
July 24	E. S. Fuller	235	1,110	3.30	1,610
26	W. M. O'Neill	232	1,100	3.28	1,690
Aug. 23	E. S. Fuller	230	886	3.10	1,670
Oct. 22	W. M. O'Neill	243	1,050	3.83	2,310
23	O'Neill and Hartwell	243	1,020	3.84	2,150

Daily gage height, in feet, of North Fork of Snake River near Rexburg, Idaho, for 1909.

[Norman Thompson, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		3.5	7.9	8.0	3.1	3.4	4.0	3.9	4.5
2		3.4	7.8	7.9	3.0	3.75	4.05	3.9	4.5
3		3.4	8.2	8.0	2.95	4.0	4.1	3.9	4.4
4		3.65	8.3	8.1	2.85	3.9	4.1	3.9	4.4
5		4.4	8.5	8.1	2.75	4.0	4.1	3.85	4.4
6		4.95	8.7	8.25	2.6	4.1	4.1	3.85	4.4
7		4.75	8.7	8.25	2.8	4.3	4.1	3.85	6.3
8		4.75	8.4	7.8	2.7	4.45	4.05	3.8	7.6
9		5.3	8.3	7.15	2.65	4.45	4.05	3.8	7.6
10		5.6	8.1	6.65	2.5	4.4	4.05	3.95	8.4
11		5.75	7.7	6.0	2.5	4.3	4.05	4.0	8.4
12		5.9	7.2	5.9	2.4	4.2	4.0	3.9	7.6
13	2.9	5.8	6.6	5.6	2.4	4.15	4.0	3.9	6.8
14	2.9	5.6	6.45	5.25	2.5	4.1	4.0	3.95	6.0
15	2.85	5.3	6.7	5.0	2.5	4.1	4.0	3.95	5.9
16	2.95	5.35	7.0	4.8	2.55	4.1	4.0	3.95	5.9
17	3.1	5.55	7.6	4.5	2.6	4.1	3.95	3.9	5.9
18	3.2	5.1	7.8	4.4	3.0	4.05	3.95	3.9	5.9
19	3.5	4.95	8.3	4.2	3.1	4.05	3.95	3.9	5.9
20	3.5	4.85	8.4	4.1	2.95	4.0	3.9	4.0	5.9
21	3.4	5.3	8.4	3.9	2.95	4.0	3.85	4.3	5.8
22	3.25	5.8	8.5	3.7	3.0	4.0	3.8	4.9	5.8
23	3.1	6.65	8.5	3.5	3.1	3.9	3.8	5.0	5.75
24	3.1	7.6	8.3	3.3	3.1	3.9	3.8	5.05	5.75
25	3.2	7.5	8.0	3.3	3.15	3.95	3.8	5.65	5.7

Daily gage height, in feet, of North Fork of Snake River near Rexburg, Idaho, for 1909—Continued.

Days.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	3.4	7.6	7.95	3.3	3.25	3.9	3.8	5.8	5.6
27	3.9	7.9	7.95	3.35	3.25	3.9	3.8	5.45	5.6
28	4.2	8.1	7.95	3.4	3.05	3.9	3.8	5.0	5.5
29	4.2	8.25	8.15	3.5	3.1	3.9	3.8	4.8	5.3
30	3.8	8.25	8.0	3.25	3.1	3.9	3.8	4.5	5.3
31	.....	8.2	.....	3.2	3.15	.....	3.85	.....	5.3

NOTE.—Ice conditions during greater part of December. Ice thickness at gage reported Dec. 19 as 4 inches and Dec. 30 as 8 inches. River entirely frozen over Dec. 31.

Daily discharge, in second-feet, of North Fork of Snake River near Rexburg, Idaho, for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2,160	6,790	6,690	1,560	1,890	2,390	2,300
2	.....	2,080	6,670	6,560	1,480	2,170	2,440	2,300
3	.....	2,080	7,180	6,690	1,450	2,390	2,480	2,300
4	.....	2,300	7,300	6,820	1,410	2,300	2,480	2,300
5	.....	3,040	7,420	6,820	1,340	2,390	2,480	2,260
6	.....	3,620	7,680	7,010	1,240	2,480	2,480	2,260
7	.....	3,400	7,680	7,010	1,370	2,670	2,480	2,260
8	.....	3,400	7,280	6,430	1,310	2,820	2,440	2,210
9	.....	4,020	7,010	6,230	1,320	2,820	2,440	2,210
10	.....	4,380	6,750	5,040	1,220	2,770	2,440	2,340
11	.....	4,560	6,230	4,250	1,220	2,670	2,440	2,390
12	.....	4,730	5,660	4,140	1,160	2,570	2,390	2,300
13	1,680	4,620	4,720	3,790	1,180	2,520	2,390	2,300
14	1,680	4,380	4,540	3,400	1,250	2,480	2,390	2,340
15	1,640	4,020	4,850	3,140	1,250	2,480	2,390	2,340
16	1,710	4,080	5,230	2,930	1,280	2,480	2,390	2,340
17	1,830	4,320	5,980	2,630	1,310	2,480	2,340	2,300
18	1,910	3,800	6,240	2,540	1,590	2,440	2,340	2 300
19	2,160	3,620	6,900	2,350	1,660	2,440	2,340	2,300
20	2,160	3,520	7,140	2,320	1,560	2,390	2,300	2,390
21	2,080	4,020	7,140	2,150	1,560	2,390	2,260	2,670
22	1,950	4,620	7,260	1,980	1,590	2,390	2,210	3,270
23	1,830	5,680	7,260	1,810	1,660	2,300	2,210	3,380
24	1,830	6,770	7,000	1,650	1,660	2,300	2,210	3,440
25	1,910	6,640	6,610	1,650	1,700	2,340	2,210	4,110
26	2,080	6,770	6,540	1,650	1,770	2,300	2,210	4,290
27	2,540	7,170	6,540	1,690	1,770	2,300	2,210	3,880
28	2,830	7,210	6,540	1,730	1,620	2,300	2,210	3,380
29	2,830	7,400	6,810	1,810	1,660	2,300	2,210	3,170
30	2,440	7,400	6,690	1,670	1,660	2,300	2,210	2,870
31	.....	7,340	.....	1,640	1,700	.....	2,260	.....

NOTE.—Daily discharges are based on rating curves applicable as follows: May 13 to Aug. 14, indirect method for shifting channels; Aug. 15 to Nov. 30, poorly defined.

Monthly discharge of North Fork of Snake River near Rexburg, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 13–30	2,830	1,640	2,060	73,500	C.
May	7,400	2,080	4,620	284,000	C.
June	7,680	4,540	6,590	392,000	C.
July	7,010	1,640	3,750	231,000	C.
August	1,770	1,160	1,470	90,400	B.
September	2,820	1,890	2,430	145,000	B.
October	2,480	2,210	2,340	144,000	B.
November	4,290	2,210	2,680	159,000	B.
December	.....	.....	[a] 2,400	148,000	D.
The period	.....	.....	.....	1,670,000	

[a] Estimated by comparison with other stations in Snake River drainage.

FALL RIVER AT FREMONT, IDAHO.

This station, which was established January 1, 1904, in order to determine the amount of flood water available for storage in the Fall River meadows reservoir site, is located at the discontinued Fremont post office about 9 miles southeast of Marysville, Idaho.

As the river receives no important tributaries below the station the records show practically the total run-off from the Fall River drainage area. Two comparatively small irrigation canals divert above the station.

The records are affected by ice during the winter months but are not affected by artificial control above or below. The gage datum has remained unchanged since the station was established. The cross section is rough but permanent.

This station was discontinued June 30, 1909.

The following discharge measurement was made by E. S. Fuller:

May 22, 1909: Width, 144 feet; area, 445 square feet; gage height, 3.9 feet; discharge, 2,470 second-feet.

Daily gage height, in feet, and discharge, in second-feet, of Fall River at Fremont, Idaho, for 1909.

[Dollie Sheetz, observer.]

Day.	February.		March.		April.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.9	425	1.85	395	1.9	425	4.2	2,970
2			1.9	425	1.9	425	1.9	425	4.4	3,310
3			1.9	425	1.9	425	2.0	485	4.65	3,780
4			1.9	425	1.9	425	2.3	700	4.85	4,160
5			1.9	425	1.9	425	2.3	700	4.85	4,160
6			1.9	425	1.95	455	2.5	860	4.5	3,500
7			1.9	425	1.95	455	2.7	1,040	4.6	3,690
8			1.8	365	1.95	455	3.0	1,340	4.2	2,970
9			1.8	365	1.95	455	3.0	1,340	3.8	2,340
10			1.8	365	1.95	455	3.2	1,560	3.6	2,080
11			1.85	395	1.95	455	3.0	1,340	3.5	1,940
12			1.9	425	1.95	455	3.0	1,340	3.6	2,080
13			1.8	365	1.95	455	2.9	1,220	3.65	2,140
14			1.8	365	2.0	485	3.1	1,440	3.75	2,280
15			1.8	365	2.0	485	3.2	1,560	4.0	2,660
16			1.8	365	2.0	485	3.2	1,560	4.2	2,970
17			1.8	365	2.0	485	3.6	2,080	4.5	3,500
18			1.8	365	2.0	485	3.6	2,080	4.65	3,780
19			1.85	395	2.5	860	3.7	2,200	4.85	4,160
20			1.8	365	2.0	485	3.6	2,080	4.7	3,880
21			1.8	365	2.0	485	3.9	2,500	4.75	3,980
22			1.8	365	2.5	860	3.9	2,500	4.65	3,780
23			1.8	365	2.5	860	3.9	2,500	4.5	3,500
24			1.8	365	3.0	1,340	4.0	2,660	4.6	3,690
25			1.8	365	3.0	1,340	4.2	2,970	4.65	3,780
26			1.8	365	2.9	1,220	4.2	2,970	4.75	3,980
27			1.8	365	2.9	1,220	4.0	2,660	4.85	4,160
28	1.9		1.8	365	3.0	1,340	3.9	2,500	4.75	3,980
29			1.85	395	3.0	1,340	3.9	2,500	4.75	3,980
30			1.85	395	1.9	425	3.9	2,500	4.75	3,980
31			1.85	395			4.2	2,970		

NOTE.—The daily discharges are based on a rating curve well defined above 365 second-feet.

Monthly discharge of Fall River at Fremont, Idaho, for 1909.

[Drainage area, 390 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March	425	365	385	0.987	1.14	23,700	A.
April	1,340	395	664	1.70	1.90	39,500	A.
May	2,970	425	1,770	4.54	5.23	109,000	A.
June	4,160	1,940	3,370	8.64	9.64	201,000	A.

TETON RIVER NEAR ST. ANTHONY, IDAHO.

This station, which was established April 23, 1903, to obtain data for use in connection with proposed irrigation work on Teton River and to determine the amount of flood water available for storage, is located at the bridge on the stage road from St. Anthony to Victor, about 7 miles from St. Anthony.

No tributaries of any importance enter below the station. The principal tributaries above are Canyon Creek, entering about 10 miles above, and North Fork, entering about 20 miles above. The Teton canal diverts water above the station.

The records are somewhat affected by ice during the winter months, but are not affected by artificial control above or below. The gage datum has remained unchanged since the station was established. The records may be considered good.

This station was discontinued June 30, 1909.

The following discharge measurement was made by E. S. Fuller:

May 23, 1909: Width, 98 feet; area, 498 square feet; gage height, 3.75 feet; discharge, 2,070 second-feet.

Daily gage height, in feet, and discharge, in second-feet, of Teton River near St. Anthony, Idaho, for 1909.

[Priscilla Ferguson, observer.]

Day.	January.		February.		March.		April.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1	2.4	520	1.9	610	1.4	310	1.8	548	2.5	1,020	4.2	2,730
2	2.4	520	1.8	548	1.4	310	1.9	610	2.2	808	5.1	4,300
3	2.4	520	1.7	487	1.45	339	2.5	1,020	2.1	740	5.7	5,440
4	2.4	520	1.7	487	1.45	339	2.4	950	2.3	878	6.7	7,420
5	2.4	520	1.7	487	1.5	368	2.2	808	2.7	1,180	6.8	7,620
6	2.4	520	1.7	487	1.55	398	1.95	642	2.7	1,180	6.8	7,620
7	2.3	520	1.7	487	1.6	427	1.95	642	2.45	987	6.7	7,420
8	2.3	520	1.7	487	1.7	487	2.0	674	2.55	1,060	5.75	5,540
9	2.2	520	1.8	548	1.7	487	1.95	642	2.6	1,100	5.0	4,120
10	2.0	520	1.8	548	1.4	310	1.9	610	2.7	1,180	4.6	3,380
11	1.8	548	1.85	579	1.3	253	1.9	610	3.0	1,420	4.0	2,440
12	1.9	610	1.9	610	1.5	368	1.8	548	2.7	1,180	3.9	2,300
13	2.0	674	1.9	610	1.6	427	1.8	548	2.5	1,020	3.95	2,370
14	2.0	674	1.9	610	1.5	368	1.95	642	2.45	987	4.1	2,580
15	2.0	674	1.8	548	1.45	339	2.0	674	2.5	1,020	4.35	2,960

Daily gage height, in feet, and discharge, in second-feet, of Teton River near St. Anthony, Idaho, for 1909—Continued.

Day.	January.		February.		March.		April.		May.		June.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
16	1.9	610	1.8	548	1.45	339	2.4	950	2.85	1,300	5.05	4,210
17	1.9	610	1.75	518	1.45	339	2.5	1,020	2.7	1,180	5.4	4,880
18	1.9	610	1.7	487	1.5	368	2.95	1,380	2.7	1,180	6.0	6,020
19	1.9	610	1.6	427	1.5	368	2.55	1,060	2.7	1,180	6.0	6,020
20	2.0	674	1.6	427	1.5	368	2.56	1,060	2.75	1,220	5.9	5,820
21	2.0	674	1.6	427	1.5	368	2.55	1,060	2.95	1,380	5.8	5,640
22	2.0	674	1.6	427	1.5	368	2.0	674	3.2	1,580	5.55	5,160
23	2.0	674	1.55	398	1.55	398	2.0	674	3.75	2,120	5.4	4,880
24	1.9	610	1.55	398	1.55	398	2.0	674	3.85	2,240	5.2	4,500
25	1.9	610	1.55	398	1.55	398	2.1	740	3.9	2,300	5.1	4,300
26	1.9	610	1.5	368	1.6	427	2.1	740	4.2	2,730	5.6	5,260
27	1.9	610	1.5	368	1.6	427	2.2	808	4.85	3,830	5.45	4,970
28	1.9	610	1.4	310	1.6	427	2.3	878	5.2	4,500	5.5	5,060
29	1.9	610	.....	.....	1.65	457	2.2	808	5.0	4,120	5.55	5,160
30	1.9	610	.....	.....	1.65	457	2.2	808	4.4	3,040	5.35	4,780
31	1.9	610	.....	.....	1.65	457	.....	.....	5.15	4,400	.....	.....

NOTE.—River frozen over Jan. 1 to 10. Discharge estimated. Daily discharges except as noted are based on a rating curve that is fairly well defined between 370 and 2,400 second-feet.

Monthly discharge of Teton River near St. Anthony, Idaho, for 1909.

[Drainage area, 960 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	674	520	593	0.618	0.71	36,500	B.
February	610	310	487	.507	.53	27,000	B.
March	487	253	384	.400	.46	23,600	B.
April	1,380	548	783	.816	.91	46,600	B.
May	4,500	740	1,740	1.81	2.09	107,000	B.
June	7,620	2,300	4,830	5.03	5.61	287,000	B.
The period	.....	.....	.....	.....	.....	528,000	

BLACKFOOT RIVER DRAINAGE BASIN.

DESCRIPTION.

Blackfoot River rises on the western slopes of the Preuss Range, in the southeastern part of Bannock County, Idaho, and flows northwestward to a point about 6 miles east of Presto, whence its course is southwestward to its junction with the Snake at Blackfoot. It is about 80 miles long and much of its drainage area is mountainous.

BLACKFOOT RIVER NEAR HENRY, IDAHO.[1]

This station, which is located 200 feet below the wagon bridge at Rockyford, 1 mile below the dam, and 45 miles from Rossfork, the most convenient railway station, was established July 15, 1908, to

[1] This station called "near Rossfork" in Water-Supply Paper 252, p. 231.

determine the amount of water available for storage at the reservoir at Blackfoot Marsh, now under construction by the Indian Office. The dam and station are near Henry post office.

No tributaries enter the river between this station and the dam above and no water is diverted. The principal tributaries between the station and the mouth of the canyon below are Corral, Brush, and Wolverine creeks.

A vertical timber gage is set on the left bank above the cable from which discharge measurements are made.

The records are somewhat affected by ice during the winter, but a fairly good estimate of winter flow can be made. Gage heights show no effect of artificial control below, but some irregularity in daily flow may be caused by operations at the dam above.

The gage datum has remained unchanged since the station was established.

Discharge measurements of Blackfoot River near Henry, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	U. W. Irsfeld	71	133	2.40	544
26	do	74	181	3.10	880
May 4	do	74	217	3.60	1,280
7	do	74	235	3.85	1,420
11	do	74	240	3.95	1,520
14	do	75	256	4.15	1,060
June 17	do	74	182	3.10	932
Sept. 1[a]	E. S. Fuller	68	91	1.90	216
1[a]	do	68	91	1.90	212
1[a]	do	68	91	1.90	212
Oct. 10	Fuller and Hartwell	67	96	2.08	278

[a] Made by wading.

Daily gage height, in feet, of Blackfoot River near Henry, Idaho, for 1909.

[J. M. Douglass, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.3	2.45	2.2	.....	3.6	3.85	2.5	.....	1.9	2.1	2.02	2.43
2	2.25	2.5	2.2	1.6	3.6	3.8	2.45	.....	1.85	2.1	2.03	2.40
3	2.3	2.4	2.2	1.7	3.6	3.7	2.45	2.0	1.85	2.1	2.03	2.40
4	2.3	2.4	2.2	.....	3.6	3.55	2.4	2.0	1.85	2.1	2.03	2.38
5	2.3	2.4	2.2	1.7	3.6	3.4	2.35	2.0	1.85	2.05	2.03	2.37
6	2.3	2.3	2.2	1.6	3.7	.....	2.3	2.0	1.9	2.05	2.03	2.35
7	2.2	2.35	2.2	1.7	3.85	3.3	.....	2.0	1.9	2.09	2.03	2.30
8	2.2	2.4	2.2	1.8	4.0	3.2	2.25	2.0	1.95	2.09	2.03	2.30
9	2.4	2.4	2.2	1.8	4.0	3.2	2.25	1.95	1.95	2.09	2.03	2.28
10	2.4	2.35	2.2	1.8	4.0	.....	2.25	1.9	1.95	2.08	2.03	2.28
11	2.5	2.4	2.2	.....	3.95	.....	2.25	1.97	2.0	2.08	2.03	2.28
12	2.45	2.4	2.2	1.8	4.0	3.4	2.25	1.97	2.0	2.08	2.03	2.26
13	2.4	2.3	2.0	1.8	4.1	3.35	2.2	1.95	2.0	2.08	2.03	2.25
14	2.6	2.3	2.0	1.8	4.15	3.35	2.2	1.93	2.0	2.08	2.03	2.25
15	2.6	2.2	1.85	1.8	4.0	3.25	2.2	1.93	2.0	2.08	2.02	2.30
16	2.4	2.2	.....	1.9	.....	3.2	2.15	1.92	2.1	2.08	2.04	2.35
17	2.4	2.2	.....	1.9	3.9	.....	2.15	1.92	2.1	2.08	2.04	2.40
18	2.4	2.2	.....	2.3	3.85	3.0	2.1	1.92	2.1	2.09	2.02	2.43
19	2.4	2.2	.....	2.4	3.8	3.0	2.1	1.91	2.1	2.09	2.03	2.55
20	2.3	2.2	.....	2.5	3.7	2.95	2.1	1.9	2.1	2.17	2.03	2.70

Daily gage height, in feet, of Blackfoot River near Henry, Idaho, for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.2	2.25	.....	2.5	3.65	2.9	2.1	1.9	2.1	2.02	2.06	2.75
22	2.3	2.3	.....	2.6	3.55	2.85	2.05	1.9	2.1	1.97	2.08	2.80
23	2.2	2.2	.....	2.6	3.5	2.8	2.05	1.9	2.1	1.97	2.10	2.70
24	2.3	2.2	.....	2.65	3.45	2.8	.....	1.9	2.1	2.0	2.12	2.65
25	2.4	2.2	.....	2.7	3.5	2.75	2.05	1.9	2.1	2.0	2.20	2.60
26	2.4	2.2	1.7	3.2	3.5	2.7	2.0	1.9	2.1	2.01	2.25	2.45
27	2.4	2.2	.....	3.55	3.6	2.65	2.0	1.8	2.1	2.15	2.25	2.25
28	2.3	2.2	1.75	3.65	3.7	2.6	2.0	1.8	2.1	2.11	2.35	2.15
29	2.4	.....	.....	3.7	3.65	2.6	2.0	1.78	2.1	2.01	2.40	2.50
30	2.45	.....	.....	3.6	3.65	2.55	2.0	1.8	2.1	2.01	2.43	2.70
31	2.45	.....	.....	.....	3.75	.....	.....	1.85	.....	2.01	.....	2.20

NOTE.—Ice conditions affected gage heights, in varying amounts for January, February, March, the latter part of November, and during December.

Daily discharge, in second-feet, of Blackfoot River near Henry, Idaho, for 1908–9.

Day.	[a] 1908					[b] 1909							
	Aug.	Sept.	Oct.	Nov.	Dec.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	161	202	202	248	138	1,260	1,440	502	248	216	285	255
2	.....	161	202	202	216	138	1,260	1,400	472	248	202	285	259
3	.....	161	202	202	202	161	1,260	1,330	472	248	202	285	259
4	.....	161	202	202	216	161	1,260	1,220	439	248	202	285	259
5	.....	161	202	202	216	161	1,260	1,120	410	248	202	266	259
6	.....	161	202	202	216	138	1,330	1,080	381	248	216	266	259
7	.....	161	202	202	216	161	1,440	1,050	368	248	216	281	259
8	.....	161	202	202	202	187	1,540	980	354	248	232	281	259
9	.....	161	216	202	202	187	1,540	980	354	232	232	281	259
10	.....	161	202	202	187	187	1,540	1,030	354	216	232	278	259
11	.....	161	202	202	174	187	1,500	1,070	354	238	248	278	259
12	.....	161	202	202	187	187	1,540	1,120	354	238	248	278	259
13	.....	161	202	202	187	187	1,610	1,080	328	232	248	278	259
14	.....	161	202	216	187	187	1,640	1,080	328	226	248	278	259
15	150	161	216	202	180	187	1,540	1,020	328	226	248	278	255
16	150	174	216	232	180	216	1,500	980	306	222	285	278	262
17	150	187	216	248	180	216	1,470	911	306	222	285	278	262
18	150	187	216	216	180	381	1,440	842	285	222	285	281	262
19	150	187	216	202	180	439	1,400	842	285	219	285	281	249
20	161	187	216	187	180	502	1,330	808	285	216	285	315	249
21	161	187	216	216	180	502	1,300	774	285	216	285	255	250
22	161	187	216	187	180	570	1,220	740	266	216	285	238	250
23	161	187	216	216	180	570	1,190	706	266	216	285	238	250
24	161	187	216	187	180	602	1,160	706	266	216	285	248	250
25	161	187	216	202	180	638	1,190	672	266	216	285	248	250
26	161	187	216	202	180	980	1,190	638	248	216	285	252	250
27	161	187	216	187	180	1,220	1,260	604	248	187	285	306	250
28	161	187	216	187	180	1,300	1,330	570	248	187	285	289	250
29	161	187	216	381	180	1,330	1,300	570	248	182	285	252	250
30	161	187	202	248	180	1,260	1,300	536	248	187	285	252	250
31	161	.....	202	.....	180	.....	1,360	.....	248	202	.....	252	.....

[a] Discharges in 1908 are based on a rating curve that is fairly well defined between 200 and 1,700 second-feet. Discharges Dec. 15 to 31, 1908, estimated because of ice conditions.

[b] Discharge estimated for ice conditions Nov. 18 to 30, 1909. Discharge interpolated on days in April to November, 1909, having no gage record. Daily discharges for open-water period not covered by above note are based on a rating curve that is fairly well defined between 200 and 1,700 second-feet.

Monthly discharge of Blackfoot River near Henry, Idaho, for 1908–9.

Months.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1908.					
August 15–31	161	150	158	5,330	D.
September	187	161	174	10,400	C.
October	216	202	209	12,900	B.
November	381	187	211	12,600	B.
December	248	174	191	11,700	D.
1909.					
January	.....	.....	[a] 170	10,500	D.
February	.....	.....	[a] 160	8,890	D.
March	.....	.....	[a] 150	9,220	D.
April	1,330	138	443	26,400	D.
May	1,640	1,160	1,370	84,200	C.
June	1,440	536	930	55,300	A.
July	502	248	326	20,000	A.
August	248	182	224	13,800	A.
September	285	202	256	15,200	A.
October	315	238	272	16,700	A.
November	.....	.....	255	15,200	C.
December	.....	.....	[a] 250	15,400	D.
The year	.....	.....	400	291,000	

[a] Estimated because of ice conditions.

BLACKFOOT RIVER NEAR SHELLEY, IDAHO.

This station, which is located in sec. 7, T. 2 S., R. 38 E., Boise meridian, about 1½ miles above the mouth of the canyon, 18 miles northeast from Blackfoot, and about 10 miles southeast from Shelley, the nearest post office and railway station, was established June 26, 1909, to determine the total flood waters available from Blackfoot River for storage.

The principal tributaries that enter the Blackfoot between this station and the Indian Office dam, 37 miles above, are Corral Creek, 30 miles above; Brush Creek, 15 miles above; and Wolverine Creek, 1 mile above. The river receives no important tributaries below the station and no important diversions above.

A vertical staff gage in a stilling box is located on the right bank 20 feet above the cable from which discharge measurements are made. A Friez improved automatic gage is located on the right bank 10 feet above the cable, inclosed in a small gage house. The automatic gage is set weekly to correspond with the staff gage.

During December and January ice makes it impossible to get good records. The gage heights are unaffected by control below, but some irregularity of flow is caused by the operation of the gates on the Indian Office dam above. The gage datum has remained unchanged since the station was established.

Discharge measurements of Blackfoot River near Shelley, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 28	E. S. Fuller	90	205	4.67	723
29	do			4.67	[a] 624
July 23	do	88.5	153	4.08	425
Aug. 29	do	89	132	3.90	297
30	do			3.85	[a] 226
Sept. 4[b]	do			3.96	268
4[c]	do	88.5	135	3.96	257
Oct. 8	O. W. Hartwell	88.5	153	4.15	331
8	E. S. Fuller	88.5	153	4.15	319
14[b]	do			4.15	338

[a] Discharge measured at Presto and canal diversions between Presto and Shelley added.
[b] Made by wading one-half mile below gage.
[c] Made by wading at gage.

Daily gage height, in feet, of Blackfoot River near Shelley, Idaho, for 1909.

[R. E. Reid, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.61	4.02	3.92	4.07	4.13	4.63
2		4.61	4.02	3.92	4.07	4.13	4.63
3		4.61	4.02	3.92	4.16	4.13	4.63
4		4.61	4.02	3.92	4.16	4.13	4.63
5		4.36	4.02	4.02	4.16	4.13	
6		4.36	4.02	4.02	4.16	4.13	
7		4.36	4.02	4.02	4.16	4.14	
8		4.36	3.99	4.02	4.16	4.14	
9		4.36	3.99	4.02	4.16	4.14	
10		4.36	3.99	4.02	4.15	4.14	
11		4.21	3.99	4.02	4.15	4.14	
12		4.21	3.99	4.06	4.15	4.14	
13		4.21	3.99	4.06	4.15	4.14	
14		4.21	3.99	4.06	4.15	4.14	
15		4.21	3.94	4.06	4.15	4.14	
16		4.21	3.94	4.06	4.15	4.14	
17		4.21	3.94	4.06	4.15	4.14	
18		4.10	3.94	4.06	4.15	4.14	
19		4.10	3.94	4.05	4.15	4.14	
20		4.10	3.94	4.05	4.15	4.14	
21		4.10	3.94	4.05	4.15	4.36	
22		4.10	3.90	4.05	4.15	4.36	
23		4.10	3.90	4.05	4.15	4.36	
24		4.10	3.90	4.05	4.14	4.36	
25		4.08	3.90	4.05	4.14	4.36	
26	4.87	4.08	3.90	4.07	4.14	4.36	
27	4.83	4.08	3.90	4.07	4.14	4.36	
28	4.61	4.08	3.90	4.07	4.14	4.63	
29	4.61	4.08	3.92	4.07	4.14	4.63	
30	4.61	4.08	3.92	4.07	4.14	4.63	
31		4.08	3.92		4.13		

NOTE.—Ice conditions probably existed from about Nov. 18 to Dec. 31.

Daily discharge, in second-feet, of Blackfoot River near Shelley, Idaho, for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	586	284	248	304	330	16	.....	366	255	300	338	334
2	.....	586	284	248	304	330	17	.....	366	255	300	338	334
3	.....	586	284	248	343	330	18	.....	316	255	300	338	330
4	.....	586	284	248	343	330	19	.....	316	255	296	338	330
5	.....	442	284	284	343	330	20	.....	316	255	296	338	330
6	.....	442	284	284	343	330	21	.....	316	255	296	338	300
7	.....	442	284	284	343	334	22	.....	316	241	296	338	300
8	.....	442	272	284	343	334	23	.....	316	241	296	338	300
9	.....	442	272	284	343	334	24	.....	316	241	296	334	300
10	.....	442	272	284	338	334	25	.....	308	241	296	334	300
11	.....	366	272	284	338	334	26	757	308	241	304	334	300
12	.....	366	272	300	338	334	27	729	308	241	304	334	300
13	.....	366	272	300	338	334	28	586	308	241	304	334	300
14	.....	366	272	300	338	334	29	586	308	248	304	334	300
15	.....	366	255	300	338	334	30	586	308	248	304	334	300
							31	.....	308	248	.....	330	.....

NOTE.—These discharges are based on a rating curve that is well defined. Discharges Nov. 18 to 30 estimated by comparison of hydrographs of stations at Henry and Presto.

Monthly discharge of Blackfoot River near Shelley, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June 26–30	757	586	649	6,440	A.
July	586	308	385	23,700	A.
August	284	241	262	16.100	A.
September	304	248	289	17,200	A.
October	343	304	336	20,700	A.
November	.....	.....	331	19,700	C.

BLACKFOOT RIVER NEAR PRESTO, IDAHO.

This station, which is located on the ranch of James Just, 2 miles east of the discontinued Presto post office and about 15 miles northeast from Blackfoot, Idaho, was established April 17, 1903, to determine the amount of flood waters available for storage. The station was discontinued December 31, 1909.

No tributaries enter the river between this station and the one in the canyon 5 miles above, and there are no important tributaries below. Between this station and the station in the canyon four small irrigation canals divert about 50 second-feet of water during the irrigating season. This is about equal to the average summer inflow between this station and the Indian Office dam, 42 miles above.

Discharge measurements are made by means of a cable equipment located about one-fourth mile below the inclined staff gage.

The records are not affected by artificial control below, but some irregularities in daily flow occur, due to artificial control and ice conditions above. The gage datum has remained unchanged since the station was established.

Discharge measurements of Blackfoot River near Presto, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 15	E. C. La Rue	57	181	1.27	327
May 26[a]	E. S. Fuller	60	428	5.60	1,390
June 29	do	59	236	2.40	569
July 22	do	58	168	1.05	279
Aug. 29	do	55	142	.75	203
Sept. 4[b]	do	54	160	.85	232
Oct. 8	Fuller and Hartwell	58.5	183	1.40	332
15	O. W. Hartwell	57.5	184	1.40	323

[a] Banks overflowed. [b] Made by wading.

Daily gage height, in feet, of Blackfoot River near Presto, Idaho, for 1909.

[James Just, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.0	0.9	0.9	0.9	6.3	6.4	2.3	0.9	0.9	1.3	1.5	2.4
2	.9	.75	.6	.85	5.8	6.15	2.35	1.0	1.0	1.25	1.45	2.4
3	.8	.8	.7	1.0	6.2	5.9	2.25	1.05	1.05	1.3	1.5	2.35
4	.9	.8	.75	1.1	6.7	5.7	2.4	.9	1.0	1.3	1.5	2.5
5	.85	.75	.6	.9	6.4	5.35	2.15	.9	.9	1.35	1.55	2.6
6	1.0	.7	.8	.95	6.35	5.05	2.0	.85	.95	1.4	1.5	2.4
7	.9	.8	.5	.8	6.7	4.85	2.0	.9	.9	1.4	1.5	2.5
8	.95	.85	.7	.8	7.0	4.9	1.95	.8	1.0	1.4	1.4	2.45
9	.8	.9	.6	.85	6.9	5.15	1.9	.8	.95	1.4	1.4	2.5
10	.6	.9	.8	.9	6.8	4.9	1.8	.75	.95	1.35	1.45	2.55
11	.55	.8	.75	.7	7.0	4.65	1.65	.8	1.0	1.4	1.4	2.4
12	.7	1.0	.65	.85	7.1	4.5	1.6	.8	1.1	1.4	1.4	2.5
13	.9	1.0	.7	.8	7.3	4.5	1.5	1.0	1.15	1.4	1.5	2.5
14	1.0	.9	.5	.9	7.2	4.55	1.45	.9	1.15	1.4	1.5	2.45
15	.9	.85	.7	1.1	7.2	4.25	1.4	.9	1.2	1.4	1.55	2.5
16	1.1	.8	.6	1.35	7.35	4.1	1.4	.85	1.15	1.4	1.5	2.0
17	1.5	.9	.6	2.05	7.3	4.1	1.35	.8	1.2	1.4	1.6	2.0
18	1.75	1.0	.4	2.45	6.8	4.15	1.2	.9	1.25	1.5	1.5	2.15
19	2.0	1.0	.55	3.0	6.65	4.0	1.1	.9	1.3	.8	1.7	2.3
20	2.0	.95	.45	3.35	6.6	4.05	1.1	.95	1.25	1.6	1.8	2.5
21	1.3	.9	.5	3.55	6.3	3.8	1.1	.9	1.25	1.55	2.0	2.5
22	1.15	1.0	.7	3.4	6.25	3.45	1.05	.85	1.3	1.5	1.8	2.65
23	1.2	.8	.65	3.45	6.0	3.2	1.05	.9	1.2	1.55	1.7	2.6
24	1.3	.75	.7	3.7	5.8	3.05	1.1	.9	1.15	1.5	2.2	2.7
25	1.1	.9	.7	4.05	5.65	3.0	1.2	.85	1.2	1.4	2.2	2.65
26	1.15	.9	.85	4.8	5.6	2.8	1.25	.8	1.2	1.45	2.5	2.6
27	1.0	1.0	.7	6.1	5.75	2.75	1.2	.8	1.5	1.5	2.3	2.7
28	1.0	1.0	.7	7.0	5.6	2.6	1.1	.85	1.4	1.5	2.3	3.0
29	.9	.....	.8	7.35	5.75	2.5	1.15	.75	1.35	1.45	2.4	2.8
30	.95	.....	.85	7.0	5.95	2.45	1.0	.7	1.3	1.5	2.5	3.1
31	1.0	.....	.8	.....	6.1	.....	1.0	.75	.....	1.5	.....	3.25

NOTE.—Ice conditions Jan. 1 to 20 and probably from Nov. 19 to Dec. 31.

Daily discharge, in second-feet, of Blackfoot River near Presto, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	200	264	264	264	1,650	1,680	542	234	234	314	356
2	200	236	209	254	1,500	1,600	554	253	253	304	346
3	200	245	227	284	1,620	1,530	530	263	263	314	356
4	200	245	236	304	1,770	1,470	566	234	253	314	356
5	200	236	209	264	1,680	1,360	506	234	234	324	367
6	200	227	245	274	1,660	1,280	470	224	244	335	356
7	200	245	192	245	1,770	1,220	470	234	234	335	356
8	200	254	227	245	1,860	1,240	458	215	253	335	335
9	200	264	209	254	1,830	1,310	446	215	244	335	335
10	200	264	245	264	1,800	1,240	422	206	244	324	346

Daily discharge, in second-feet, of Blackfoot River near Presto, Idaho, for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
11	200	245	236	227	1,860	1,170	389	215	253	335	335
12	200	284	218	254	1,890	1,130	378	215	273	335	335
13	200	284	227	245	1,950	1,130	356	253	283	335	356
14	200	264	192	264	1,920	1,140	346	234	283	335	356
15	200	254	227	304	1,920	1,060	335	234	293	335	367
16	200	245	209	354	1,960	1,010	335	224	283	335	356
17	230	264	209	501	1,950	1,010	324	215	293	335	378
18	260	284	175	589	1,800	1,030	293	234	304	356	356
19	290	284	200	720	1,760	986	273	234	314	215	350
20	317	274	184	807	1,740	1,000	273	244	304	378	350
21	344	264	192	860	1,650	930	273	234	304	367	350
22	314	284	227	820	1,640	832	263	224	314	356	350
23	324	245	218	833	1,560	766	263	234	293	367	350
24	344	236	227	902	1,500	727	273	234	283	356	350
25	304	264	227	1,000	1,460	714	293	224	293	335	350
26	314	264	254	1,210	1,440	662	304	215	293	346	350
27	284	284	227	1,590	1,480	650	293	215	356	356	350
28	284	284	227	1,860	1,440	614	273	224	335	356	350
29	264	.....	245	1,960	1,480	590	283	206	324	346	350
30	274	.....	254	1,860	1,540	578	253	197	314	356	350
31	284	.....	245	.....	1,590	.....	253	206	.....	356	.....

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 21 to May 15, well defined; May 16 to Nov. 18, well defined. Discharges for ice periods (see note to gage heights) estimated.

Monthly discharge of Blackfoot River near Presto, Idaho, for 1909.

[Drainage area, 1,020 square miles.]

Months.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	344	200	246	0.241	0.28	15,100	C.
February	284	227	260	.255	.27	14,400	B.
March	264	175	222	.218	.25	13,600	B.
April	1,960	227	660	.647	.72	39,300	A.
May	1,960	1,440	1,700	1.67	1.92	105,000	A.
June	1,680	578	1,060	1.04	1.16	63,100	A.
July	566	253	364	.357	.41	22,400	A.
August	263	197	227	.223	.26	14,000	A.
September	356	234	282	.276	.31	16,800	A.
October	378	215	336	.329	.38	20,700	A.
November	.....	.....	352	.345	.38	20,900	C.
December	.....	.....	*a* 500	.490	.56	30,700	D.
The year	.....	.....	522	.512	6.90	376,000	

a Estimated.

SEEPAGE INVESTIGATIONS ON BLACKFOOT RIVER, IDAHO.

An investigation of the amount of seepage water returning to Blackfoot River between Rockyford dam, near Henry post office, Idaho, and the cable station near Presto, Idaho, a distance of about 42 miles, was made in cooperation with the United States Indian Office, October 10–15, 1909, along lines similar to the investigations on Boise River of previous years.[1]

[1] For data on the seepage investigations made on Boise River, Idaho, in 1898, 1901–1903, and 1905–1908, see Water-Supply Paper 252, pp. 248–252.

Weather conditions for this were ideal, and the maximum variation in stage of the river as recorded by a Friez automatic gage located at the mouth of the canyon about 5 miles above Presto, Idaho, showed only 0.01 foot. As the variation in the river during the investigation was so slight the measurements were treated as though made instantaneously.

A rapid reconnaissance was made between Rockyford and Presto and eight sections were chosen for river measurements, including these two. Of these, the section near Henry and the four sections chosen below Brush Creek were all good gaging sections, but the other three were less satisfactory, owing to rough stream bed and high velocities.

Twenty-one creeks and springs were found to be discharging water into the river between Rockyford and the mouth of the canyons, and all these were measured with a current meter. Between the mouth of the canyon and the Presto station four canals are taken out, but of these, only two were carrying water during the period covered by the investigation.

The results of all the measurements made are tabulated below.

Discharge of Blackfoot River at upper point plus tributaries.

Date.	Streams.	Locality of stream, canal headgate, or point of river measurement.	River discharge.	Tributary discharge.	Canal diversion.
1909.			*Sec.-ft.*	*Sec.-ft.*	*Sec.-ft.*
Oct. 10	Blackfoot River	Henry cable station at Rockyford.	277.70		
10	Corral Creek	7 miles below Rockyford		13.47	
10	Nigger Creek	9 miles below Rockyford		.57	
11	Blackfoot River	¼ mile above Upper 70 Creek	285.10		
11	Upper 70 Creek	11 miles below Rockyford		.05	
11	Lower 70 Creek	11½ miles below Rockyford		.39	
11	Higleys Creek No. 1	12 miles below Rockyford		.15	
11	Higleys Creek No. 2	12½ miles below Rockyford		.14	
11	Higleys Creek No. 3	13 miles below Rockyford No. 3		.21	
11	Blackfoot River	1 mile below Higleys Creek	303.70		
11	Grave Creek	16 miles below Rockyford		2.48	
12	Blackfoot River	½ mile below Deadman Creek	284.20		
12	Deadman Creek	18 miles below Rockyford		.39	
12	Brush Creek	22 miles below Rockyford		18.17	
13	Blackfoot River	Just above Trail Creek	310.30		
13	Trail Creek	24 miles below Rockyford		.27	
13	Beaver Creek	25 miles below Rockyford		.86	
13	Spring	25½ miles below Rockyford		.08	
13	Miner Creek	26 miles below Rockyford		3.06	
13	Spring	27 miles below Rockyford		.05	
13	Spring Creek	28 miles below Rockyford		.01	
13	Wood Creek	28½ miles below Rockyford		3.14	
13	Ten Mile Creek	29 miles below Rockyford		.43	
13	Big Spring	29½ miles below Rockyford		.75	
13	Cedar Creek	30 miles below Rockyford		1.33	
14	Blackfoot River	1 mile above Wolverine Creek	323.30		
14	Wolverine Creek	36 miles below Rockyford		13.36	
14	Blackfoot River	1½ miles below Wolverine Creek	338.40		
15	Upper Shumacher Ditch	38 miles below Rockyford			4.13
15	Lower Shumacher Ditch	40 miles below Rockyford			1.63
15	Blackfoot River	Presto cable station	332.40		
	Total tributary discharge			59.36	
	Total canal diversion				5.76

Losses and gains in the Blackfoot River, Oct. 10–15, 1909.

	Sec.-ft.	*Sec.-ft.*
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River above Upper 70 Creek	285.10	.....
Tributary inflow between Rockyford and Upper 70 Creek	.....	14.04
Loss in 10¾ miles	6.64	.....
	291.74	291.74
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River 1 mile below Higleys	303.70	.....
Tributary inflow between Rockyford and Grave Creek	.....	14.98
Gain in 14 miles	.....	11.02
	303.70	303.70
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River above Deadman Creek	284.20	.....
Tributary inflow between Rockyford and Deadman Creek	.....	17.46
Loss in 17½ miles	10.96	.....
	295.16	295.16
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River above Trail Creek	310.30	.....
Tributary inflow between Rockyford and Trail Creek	.....	36.02
Loss in 24 miles	3.42	.....
	313.72	313.72
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River above Wolverine Creek	323.30	.....
Tributary inflow between Rockyford and Wolverine Creek	.....	46.00
Loss in 35 miles	.40	.....
	323.70	323.70
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River at mouth of canyon	338.40	.....
Tributary inflow between Rockyford and mouth of canyon	.....	59.36
Gain in 37.5 miles	.....	1.34
	338.40	338.40
Discharge of Blackfoot River at Rockyford (near Henry)	.....	277.70
Discharge of Blackfoot River at Presto	332.40	.....
Tributary inflow between Rockyford and Presto	.....	59.36
Canal diversion between Rockyford and Presto	5.76	.....
Total gain between Rockyford and Presto—42 miles	.....	1.10
	338.16	338.16

BIG LOST RIVER NEAR CHILLY, IDAHO.

Big Lost River rises in the southern part of Custer County, Idaho, flows northeastward to a point about 3 miles southeast of Chilly, then turns abruptly and flows southeastward for about 50 miles. About 15 miles below Lost River it makes another turn to the northeast and 25 miles farther on its waters are lost in a sink.

The gaging station, which was established April 25, 1904, discontinued August 31, 1906, and reestablished July 1, 1907, is located at Howell's ranch, about 30 miles upstream from Mackay, Idaho, 7 miles from Chilly, the nearest post office, and 3 miles above Kinickinick Point. The records show the total amount of water available for storage at the reservoir site 3 miles above Mackay.

The stream receives no important tributaries below the station, and there are no important diversions above.

The records are not affected by artificial control above or below, but ice prevails during the winter months to such an extent that it is necessary to discontinue readings about three months. The gage datum has remained unchanged since August 20, 1906. The channel section is permanent.

Discharge measurements of Big Lost River near Chilly, Idaho, in 1907 and 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage. height.	Dis-charge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1907.					
Oct. 4	A. D. Williams	80	140	2.50	207
1909.					
May 27	E. S. Fuller	89	303	4.10	1,360
28	do	89	301	4.10	1,380
June 19	do	103	368	4.90	2,280

NOTE.—The banks were overflowed when the 1909 measurements were made.

Daily gage height, in feet, of Big Lost River near Chilly, Idaho, for 1909.

[Maud Howell, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.5	4.2	4.7	2.95	2.8	2.65	2.5
2	.....	2.55	4.6	4.7	3.0	2.9	2.6	2.45
3	.....	2.7	5.2	4.9	2.9	2.8	2.6	2.45
4	.....	3.05	5.3	4.65	2.9	2.7	2.75	2.45
5	.....	3.2	5.4	4.35	2.9	2.8	2.65	2.45
6	.....	3.0	5.2	4.1	2.85	3.0	2.65	2.45
7	.....	2.95	4.85	3.8	2.8	2.9	2.6	2.45
8	.....	3.0	4.5	3.7	2.8	2.8	2.6	2.5
9	.....	3.0	4.25	3.65	2.8	2.8	2.6	2.4
10	.....	3.1	3.95	3.6	2.8	2.7	2.6	2.4
11	2.0	3.0	3.85	3.6	2.8	2.7	2.55	2.4
12	2.0	2.8	3.8	3.5	2.8	2.65	2.55	2.4
13	2.05	2.8	3.7	3.45	2.8	2.6	2.55	2.4
14	2.1	2.9	3.85	3.45	2.7	2.6	2.55	.....
15	2.15	3.0	4.15	3.45	2.7	2.55	2.55	.....
16	2.2	2.95	4.6	3.4	2.7	2.55	2.55	.....
17	2.25	2.9	4.8	3.4	2.7	2.55	2.5	.....
18	2.25	2.9	5.0	3.35	2.7	2.55	2.5	.....
19	2.2	3.0	4.8	3.3	2.7	2.5	2.5	.....
20	2.3	3.1	4.5	3.4	2.65	2.5	2.5	.....
21	2.3	3.3	4.25	3.25	2.65	2.5	2.5	.....
22	2.3	3.5	4.2	3.2	2.65	2.5	2.5	.....
23	2.3	3.5	4.25	3.2	2.65	2.5	2.45	.....
24	2.35	3.5	4.35	3.25	2.6	2.5	2.45	.....
25	2.4	3.5	4.2	3.15	2.6	2.45	2.45	.....
26	2.5	3.6	4.2	3.2	2.6	2.45	2.45	.....
27	2.55	4.05	4.2	3.2	2.55	2.55	2.45	.....
28	2.5	4.0	4.5	3.1	2.55	2.55	2.45	.....
29	2.5	3.8	4.6	3.0	2.5	2.8	2.45	.....
30	2.45	3.6	4.75	3.0	2.5	2.7	2.45	.....
31	.....	3.7	.....	2.95	2.8	.....	2.35	.....

NOTE.—River frozen over from Jan. 1 to Apr. 10, and Nov. 14 to Dec. 31.

Daily discharge, in second-feet, of Big Lost River near Chilly, Idaho, for 1907–1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Day.	July.	Aug.	Sept.	Oct.	Nov.
1907.						1907.					
1	2,150	1,110	340	207	207	16	1,260	538	272	186	166
2	2,150	1,110	340	207	207	17	1,160	505	272	186	.....
3	2,210	1,260	365	207	207	18	1,260	505	272	186	.....
4	2,210	1,110	365	207	207	19	1,370	505	250	186	.....
5	2,180	960	390	207	166	20	1,540	445	250	186	.....
6	2,150	830	365	207	166	21	1,420	445	250	186	.....
7	2,150	830	365	207	166	22	1,370	445	250	186	.....
8	2,150	790	340	207	166	23	1,320	445	250	186	.....
9	2,090	750	340	207	166	24	1,320	505	250	186	.....
10	1,980	640	340	207	166	25	1,260	505	207	186	.....
11	1,980	640	318	207	166	26	1,260	475	207	186	.....
12	1,920	570	295	207	166	27	1,320	445	207	186	.....
13	1,810	570	295	186	166	28	1,210	390	207	207	.....
14	1,640	570	295	186	166	29	1,210	390	207	207	.....
15	1,480	570	295	186	166	30	1,160	365	207	207	.....
						31	1,110	340	.....	207	.....

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.									
1	.....	42	295	445	1,480	475	207	207	207
2	.....	35	340	475	1,480	505	207	207	207
3	.....	50	340	505	1,700	418	207	207	207
4	.....	60	340	505	1,810	390	207	207	186
5	.....	60	340	505	1,640	390	207	207	186
6	.....	60	390	605	1,260	445	207	207	186
7	.....	50	505	710	1,320	390	207	207	186
8	.....	60	475	915	1,260	390	295	207	186
9	.....	60	445	1,160	1,320	390	250	207	166
10	.....	60	445	1,370	1,160	390	228	207	166
11	.....	70	390	1,370	1,160	340	207	207	166
12	.....	98	340	1,640	1,100	340	250	207	207
13	.....	114	340	1,810	1,110	295	228	207	207
14	.....	130	295	1,980	1,260	340	228	228	207
15	.....	130	340	2,030	1,110	340	250	340	166
16	.....	166	340	1,920	915	295	228	365	148
17	.....	130	318	1,760	830	295	250	318	166
18	.....	166	295	1,480	750	295	272	250	166
19	.....	207	295	1,320	710	390	250	250	166
20	.....	250	295	1,060	710	365	250	250	166
21	.....	295	295	960	710	365	250	250	166
22	.....	340	295	870	710	340	250	250	166
23	.....	318	295	790	710	318	228	250	166
24	.....	295	295	830	675	295	207	250	148
25	.....	250	318	960	640	295	207	250	166
26	.....	250	340	1,370	605	295	207	250	186
27	.....	250	340	1,370	570	272	207	228	186
28	.....	250	340	1,260	570	250	207	228	186
29	42	250	390	1,160	505	250	207	228	186
30	50	250	418	1,370	475	228	207	207	186
31	42	.....	445	.....	445	228	.....	207	.....

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.								
1	.....	207	1,480	2,030	418	340	272	207
2	.....	228	1,920	2,030	445	390	250	186
3	.....	295	2,630	2,270	390	340	250	186
4	.....	475	2,750	1,980	390	295	318	186
5	.....	570	2,880	1,640	390	340	272	186
6	.....	445	2,630	1,370	365	445	272	186
7	.....	418	2,210	1,060	340	390	250	186
8	.....	445	1,810	960	340	340	250	207
9	.....	445	1,540	915	340	340	250	166
10	.....	505	1,210	870	340	295	250	166

Daily discharge, in second-feet, of Big Lost River near Chilly, Idaho, for 1907-1909—Continued.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1909.								
11	50	445	1,110	870	340	295	228	166
12	50	340	1,060	790	340	272	228	166
13	60	340	960	750	340	250	228	166
14	70	390	1,110	750	295	250	228	.....
15	84	445	1,420	750	295	228	228	.....
16	98	418	1,920	710	295	228	228	.....
17	114	390	2,150	710	295	228	207	.....
18	114	390	2,390	675	295	228	207	.....
19	98	445	2,150	640	295	207	207	.....
20	130	505	1,810	710	272	207	207	.....
21	130	640	1,540	605	272	207	207	.....
22	130	790	1,480	570	272	207	207	.....
23	130	790	1,540	570	272	207	186	.....
24	148	790	1,640	605	250	207	186	.....
25	166	790	1,480	538	250	186	186	.....
26	207	870	1,480	570	250	186	186	.....
27	228	1,320	1,480	570	228	228	186	.....
28	207	1,260	1,810	505	228	228	186	.....
29	207	1,060	1,920	445	207	340	186	.....
30	186	870	2,090	445	207	295	186	.....
31	.....	960	.....	418	340	.....	148	.....

NOTE.—Daily discharges for 1907 to 1909 are based on a rating curve fairly well defined between 166 and 3,010 second-feet.

Monthly discharge of Big Lost River near Chilly, Idaho, for 1907–1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
1907.					
July	2,210	1,110	1,640	101,000	B.
August	1,260	340	631	38,800	B.
September	390	207	287	17,100	B.
October	207	186	197	12,100	B.
November 1-16	207	166	176	5,590	C.
1908.					
April	340	35	158	9,400	C.
May	505	295	353	21,700	B.
June	2,030	445	1,150	68,400	B.
July	1,810	445	992	61,000	B.
August	505	228	342	21,000	B.
September	295	207	227	13,500	B.
October	365	207	235	14,400	B.
November	207	148	180	10,700	C.
The period	.....	.....	.....	220,000	
1909.					
April 11-30	228	50	130	5,160	C.
May	1,320	207	590	36,300	B.
June	2,880	960	1,790	107,000	B.
July	2,270	418	914	56,200	B.
August	445	207	310	19,100	B.
September	445	186	273	16,200	B.
October	318	148	222	13,600	B.
November 1-13	207	166	182	4,690	.
The period	.....	.....	.....	258,000	

RAFT RIVER DRAINAGE BASIN.

DESCRIPTION.

Raft River rises on the eastern slope of Goose Creek Mountain in the southwestern part of Cassia County, Idaho, flows southeastward a short distance into Utah, then turns to the east and north, reenters Idaho, and takes a general northerly course to its junction with Snake River about 12 miles above the Minidoka dam.

RAFT RIVER NEAR BRIDGE, IDAHO.

This station, which is located at a wagon bridge on the Langford ranch, about 4 miles from Bridge, the nearest post office, and about 25 miles southeast of Albion, Idaho, in sec. 27, T. 15 S., R. 26 E., Boise meridian, was established September 18, 1909, to determine the amount of flood water available for storage in a reservoir site 4 miles above.

The river receives no important tributaries above the station. The principal tributaries below are Clear Creek, which enters about 8 miles below, and Cassia Creek, entering about 15 miles below. All the normal low-water flow is already appropriated by ranches above the station.

The vertical staff gage is attached to the right abutment on the downstream side of the bridge, from which discharge measurements are made.

The records are affected by ice during the winter months but are not affected by artificial control above or below.

The gage datum has remained unchanged since the station was established.

Discharge measurements of Raft River near Bridge, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
Sept. 18	E. C. La Rue	13	7.6	1.41	9.0
Oct. 30	O'Neill and Hartwell	20.3	8.6	1.53	17.8

Daily gage height, in feet, of Raft River near Bridge, Idaho, for 1909.

[J. T. Hawkins, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	1.48	1.55	1.65	11	.....	1.5	1.55	1.85	21	1.4	1.5	1.75	1.8
2	.....	1.48	1.55	1.65	12	.....	1.5	1.55	1.85	22	1.4	1.5	1.75	1.78
3	.....	1.48	1.55	1.65	13	.....	1.5	1.55	1.8	23	1.4	1.5	1.82	1.75
4	.....	1.49	1.55	1.65	14	.....	1.5	1.55	1.75	24	1.4	1.5	1.88	1.75
5	.....	1.5	1.55	1.65	15	.....	1.5	1.55	1.78	25	1.4	1.5	1.92	1.8
6	.....	1.5	1.55	1.7	16	.....	1.5	1.55	1.8	26	1.42	1.5	1.95	1.62
7	.....	1.5	1.55	1.75	17	.....	1.5	1.55	1.78	27	1.44	1.5	1.95	1.5
8	.....	1.5	1.55	1.75	18	1.4	1.5	1.62	1.75	28	1.46	1.58	1.70	1.45
9	.....	1.5	1.55	1.8	19	1.4	1.5	1.72	1.78	29	1.48	1.6	1.65	1.4
10	.....	1.5	1.55	1.85	20	1.4	1.5	1.75	1.8	30	1.48	1.55	1.65	1.4
										31	.....	1.55	.....	1.65

NOTE.—Ice on the river beginning about Nov. 17. Gage heights probably affected by ice conditions after this date. River frozen over Dec. 26.

Daily discharge, in second-feet, of Raft River near Bridge, Idaho, for 1909.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	14	19	28	16	.....	15	19	41
2	.....	14	19	28	17	.....	15	19	39
3	.....	14	19	28	18	8.5	15	25	36
4	.....	14	19	28	19	8.5	15	34	39
5	.....	15	19	28	20	8.5	15	36	41
6	.....	15	19	32	21	8.5	15	36	41
7	.....	15	19	36	22	8.5	15	36	39
8	.....	15	19	36	23	8.5	15	43	36
9	.....	15	19	41	24	8.5	15	49	36
10	.....	15	19	46	25	8.5	15	53	41
11	.....	15	19	46	26	9.8	15	56	35
12	.....	15	19	46	27	11	15	56	35
13	.....	15	19	41	28	12	21	32	35
14	.....	15	19	36	29	14	23	28	35
15	.....	15	19	39	30	14	19	28	35
					31	.....	19	.....	35

NOTE.—These discharges are based on a rating curve which is well defined between 8 and 25 second-feet. Discharge estimated Dec. 26–31.

Monthly discharge of Raft River at Bridge, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
September 18–30	14	8.5	9.91	256	C.
October	23	14	15.6	959	C.
November	56	19	27.8	1,650	C.
December	46	28	36.7	2,260	D.

CASSIA CREEK NEAR CONANT, IDAHO.

This station, which is located at Conant's ranch in sec. 24, T. 13 S., R. 25 E., about 15 miles southeast of Albion, Idaho, and about 5 miles above the junction of Cassia Creek with Raft River, was established September 18, 1909, to determine the amount of flood water available for storage in connection with a Carey Act project on Cassia Creek.

The creek receives no tributaries below the station. All the normal low-water flow is already appropriated by ranches above the station.

The vertical staff gage is about one-eighth mile downstream from the highway bridge at Conant's ranch.

Low-water measurements are made by wading at the gaging section. At present there is no equipment from which to make high-water measurements.

The records are somewhat affected by ice during the winter months, but are not affected by artificial control above or below.

The gage datum has remained unchanged since the station was established.

Discharge measurements of Cassia Creek near Conant, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 18	E. C. La Rue	18	13.5	1.90	9.1
Oct. 30	O'Neill and Hartwell	20	16	1.98	14.3

Daily gage height, in feet, and discharge, in second-feet, of Cassia Creek near Conant, Idaho, for 1909.

[Mrs. E. F. Conant, observer.]

Day.	Sept.		Oct.		Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.95	12	1.98	13	2.0	14
2			2.0	14	2.0	14	2.0	14
3			2.0	14	2.0	14	2.0	14
4			2.0	14	2.0	14	2.0	14
5			2.0	14	2.0	14	2.0	14
6			2.0	14	2.0	14	2.0	14
7			2.0	14	2.0	14	2.0	14
8			2.0	14	2.0	14	2.0	14
9			2.0	14	2.0	14	2.0	14
10	1.9	9.6	2.0	14	2.02	16	2.0	14
11	1.9	9.6	2.0	14	2.02	16	2.0	14
12	1.9	9.6	2.0	14	2.02	16	1.98	13
13	1.9	9.6	2.0	14	2.03	16	1.98	13
14	1.9	9.6	2.0	14	2.03	16	1.98	13
15		9.6	2.0	14	2.03	16	1.98	13
16		9.6	2.0	14	2.03	16	1.98	13
17		9.6	1.9	9.6	2.08	19	1.98	13
18	1.9	9.6	1.9	9.6	2.08	19	1.98	13
19	1.9	9.6	1.9	9.6	2.10	20	1.98	13
20	1.9	9.6	1.9	9.6	2.10	20	1.98	13
21	1.9	9.6	1.9	9.6	2.11	21	1.98	13
22	1.9	9.6	1.9	9.6	2.11	21	1.80	6.2
23	1.9	9.6	1.9	9.6	2.15	24	1.78	5.8
24	1.9	9.6	1.9	9.6	2.15	24	1.70	4.2
25	1.9	9.6	1.9	9.6	2.15	24	1.70	4.2
26	1.95	12	1.98	13	2.15	24	1.70	4.2
27	1.95	12	1.98	13	2.08	19	1.70	4.2
28	1.95	12	1.98	13	2.08	19	1.70	4.2
29	1.95	12	1.98	13	2.08	19	1.98	13
30	1.95	12	1.98	13	2.00	14	2.00	14
31			1.98	13			2.00	14

NOTE.—Observer records "freezing" for a few days beginning Nov. 27. Daily discharge has been applied as for open-channel conditions. The daily discharges are based on a rating curve not well defined. Discharges interpolated Sept. 15 to 17.

Monthly discharge of Cassia Creek near Conant, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
September	12	9.6	10.2	425	B.
October	14	9.6	12.5	769	B.
November	24	13.0	17.5	1,040	B.
December	14	4.2	11.5	707	B.

GOOSE CREEK NEAR OAKLEY, IDAHO.

Goose Creek rises on Sugar Peak, in the extreme northeastern corner of Nevada, flows southeast, east, and then in a general northeasterly course to its junction with the Snake, near Burley, in the northern part of Cassia County, Idaho. The creek is about 70 miles long (map measurement) and receives tributaries that drain both the eastern and the western slopes of Goose Creek Mountains.

The gaging station, which is located at a wagon bridge 1 mile above the Oakley dam site and about 6 miles south of Oakley, Idaho, the nearest post office, was established May 26, 1909, to determine the amount of water available for storage, in connection with a Carey Act project.

Trapper Creek joins Goose Creek one-eighth mile above the station. The principal tributaries below are Birch, Basin, and Antelope creeks.

The vertical staff gage is fastened to the downstream side of the bridge, from which the discharge measurements are made.

The records are somewhat affected by ice during the winter.

The gage datum has remained unchanged since the station was established.

Discharge measurements of Goose Creek near Oakley, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 26	W. M. O'Neill	24	89	4.29	254
June 7	do	24	83	3.82	216
7	do	24	81	3.73	203
8	do	24	77	3.62	195
Sept. 14	do	21.2	20.4	.99	34.7
14	do	21.2	20.4	.99	32.3
14	do	21.2	20.2	.99	35.3
Oct. 6	do	21	23.5	1.19	40.7
28	O'Neill and Hartwell	21.4	24.8	1.23	44.7

Daily gage height, in feet, of Goose Creek near Oakley, Idaho, for 1909.

[L. D. Cowan, observer.]

Day.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		4.17	1.66		0.93		1.28	1.50
2		4.02	1.58		2.50		1.28	1.44
3		4.08	1.59		1.80	1.00	1.27	1.40
4		4.05		1.00	1.30	1.04	1.26	1.40
5		4.04	1.57			1.04	1.26	1.42
6		3.96	1.52		1.20	1.05	1.26	1.40
7		3.83	1.50			1.06	1.27	1.41
8		3.63	1.48			1.08	1.27	1.40
9			1.47			1.10	1.28	1.48
10			1.46			1.10	1.28	1.50
11		3.21			1.10	1.10	1.30	2.20
12		3.06	1.41			1.10	1.30	2.30
13		3.15	1.38			1.20	1.30	1.38
14		2.91	1.37	.85		1.10	1.30	1.53
15		2.86	1.31		.98	1.05	1.30	1.79
16		2.65	1.29		.95	1.05	1.29	1.98
17		2.57	1.27		.92	1.04	1.20	1.81
18		2.47			.90	1.04	1.28	1.98
19		2.33	1.22		.90	1.05	1.42	1.89
20		2.38	1.21	.80	.90	1.04	1.50	1.8

Daily gage height, in feet, of Goose Creek near Oakley, Idaho, in 1909—Continued.

Days.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	.....	2.36	1.20	.....	.89	1.06	1.59	1.64
22	.....	2.28	.....	.....	.90	1.06	1.70	1.55
23	.....	2.10	.....	.....	.90	1.05	1.80	1.53
24	.....	2.07	.....	.....	.91	1.15	1.70	1.52
25	.....	.....	.....	.....	.93	1.18	1.67	1.54
26	4.20	1.92	.....	.....	.93	1.20	1.80	1.64
27	4.18	1.87	.....	.80	.93	1.23	1.72	1.78
28	4.39	1.78	.....	.....	.94	1.24	1.48	1.75
29	4.69	1.74	.....	.....	.96	1.25	1.50	1.89
30	4.62	1.68	.....	.80	.95	1.26	1.54	1.86
31	4.35	.....	.....	.85	.....	1.27	.....	1.95

NOTE.—No ice notes reported.

Daily discharge, in second-feet, of Goose Creek near Oakley, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	239	62	36	31	32	46	57
2	.....	227	61	35	118	33	46	54
3	.....	231	62	35	74	34	46	52
4	.....	229	61	34	47	36	45	52
5	.....	228	60	34	44	36	45	53
6	.....	222	58	33	42	36	45	52
7	.....	211	57	33	41	36	46	52
8	.....	197	56	32	40	37	46	52
9	.....	188	56	32	40	38	46	56
10	.....	178	55	31	39	38	46	57
11	.....	168	54	30	38	38	47	98
12	.....	157	52	30	37	38	47	104
13	.....	164	51	29	36	42	47	51
14	.....	147	50	28	34	38	47	58
15	.....	143	48	28	33	36	47	73
16	.....	128	46	27	32	36	46	85
17	.....	123	46	27	31	36	42	75
18	.....	116	44	26	30	36	46	85
19	.....	106	43	26	30	36	53	79
20	.....	110	42	26	30	36	57	74
21	.....	108	42	26	30	36	62	64
22	.....	103	41	26	30	36	68	60
23	.....	92	41	26	30	36	74	58
24	.....	90	40	26	30	40	68	58
25	.....	85	40	26	31	41	66	59
26	241	81	39	26	31	42	74	64
27	239	78	39	26	31	44	69	73
28	256	73	38	26	32	44	56	71
29	280	70	38	26	32	44	57	79
30	275	67	37	26	32	45	59	78
31	253	.....	36	28	.....	46	.....	83

NOTE.—These discharges are based on a rating curve that is well defined between 30 and 60 second-feet and also between 180 and 266 second-feet. No measurements cover the intervening stages. Discharge interpolated for days having no gage height record.

Monthly discharge of Goose Creek near Oakley, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May 26-31	280	239	25.7	3,060	A.
June	239	67	14.5	8,630	A.
July	.....	.....	48.2	2,960	B.
August	.....	.....	29.0	1,780	B.
September	.....	.....	38.5	2,290	B.
October	46	32	38.1	2,340	A.
November	74	42	53.0	3,150	A.
December	104	51	66.6	4,100	A.
The period	.....	.....	.....	28,300	

BIG COTTONWOOD CREEK NEAR OAKLEY, IDAHO.

Big Cottonwood Creek rises in the western part of Cassia County and flows northerly and northwesterly to its junction with the Snake River at Murtaugh, in Twin Falls County, about 5 miles west of Milner. The creek is about 25 miles long and its tributaries are few and unimportant.

The gaging station, which is located just above Roark's ranch, about 10 miles northwest of Oakley, the nearest post office, and about 15 miles south of Milner, the nearest railway station, was established November 27, 1909, to determine the amount of water available for a proposed Carey Act land segregation. The staff gage is spiked to a cottonwood tree on the right bank.

Measurements are made by wading, except during extreme high water.

Discharge measurements of Big Cottonwood Creek near Oakley, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
Nov. 27[a]	O. W. Hartwell	9.8	7.61	1.27	5.8
Dec. 17[a]	do	8.9	6.08	1.17	3.5

[a] Made by wading.

Daily gage height, in feet, and discharge, in second-feet, of Big Cottonwood Creek near Oakley, Idaho, for 1909.

[J. H. Roark, observer.]

Day.	Nov.		Dec.		Day.	Nov.		Dec.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1			1.3	7.0	16			1.1	2.3
2			1.3	7.0	17			1.0	.9
3			1.1	2.3	18			1.0	.9
4			1.1	2.3	19			1.0	.9
5			1.1	2.3	20			1.0	.9
6			1.1	2.3	21			1.2	4.4
7			1.1	2.3	22			1.0	.9
8			1.1	2.3	23			1.1	2.3
9			1.1	2.3	24			1.0	.9
10			1.1	2.3	25			1.1	2.3
11			1.0	.9	26			1.2	4.4
12			1.1	2.3	27			1.2	4.4
13			1.1	2.3	28	1.2	4.4	1.1	2.3
14			1.1	2.3	29	1.3	7.0	1.0	.9
15			1.1	2.3	30	1.3	7.0	1.1	2.3
					31			1.1	2.3

NOTE.—The daily discharges are based on a well-defined rating curve.

Monthly discharge of Big Cottonwood Creek near Oakley, Idaho, for 1909.

Months.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
December	7.0	0.9	2.45	151	A.

ROCK CREEK NEAR ROCK CREEK, IDAHO.

Rock Creek rises in the eastern part of Twin Falls County and flows in a general northerly and northwesterly direction about 30 miles to its junction with Snake River, 5 miles northwest of Twin Falls. Its principal tributary is Cottonwood Creek.

The gaging station, which is located on the ranch of E. M. Crockett, about 3 miles above Rock Creek post office, was established November 28, 1909, to determine the amount of water available for a proposed Carey Act land segregation.

The gage is on the left bank about 50 feet below the footbridge and is spiked to a log from which discharge measurements are made.

A good rating covering the range of stages in 1909 has been obtained and the records may be considered good.

Discharge measurements of Rock Creek near Rock Creek, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Nov. 28	O. W. Hartwell	18.5	15.3	0.78	28.6
Dec. 18	do	18.5	9.4	.50	15.2

Daily gage height, in feet, of Rock Creek near Rock Creek, Idaho, for 1909.

[E. M. Crockett, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		0.9	11		0.7	21		0.5
2		.9	12		.8	22		.5
3		.9	13		.8	23		.5
4		.8	14		.8	24		.5
5		.7	15		.7	25		.5
6		.7	16		.7	26		.5
7		.8	17		.7	27		.5
8		.8	18		.5	28	0.8	.5
9		.8	19		.5	29	.8	.5
10		.8	20		.5	30	.8	.6
						31		.6

Daily discharge, in second-feet, of Rock Creek near Rock Creek, Idaho, for 1909.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		36	11		24	21		15.4
2		36	12		30	22		15.4
3		36	13		30	23		15.4
4		30	14		30	24		15.4
5		24	15		24	25		15.4
6		24	16		24	26		15.4
7		30	17		24	27		15.4
8		30	18		15.4	28	30	15.4
9		30	19		15.4	29	30	15.4
10		30	20		15.4	30	30	19.4
						31		19.4

NOTE.—These discharges are based on a rating curve that is based on two measurements and is fairly well defined.

Monthly discharge of Rock Creek near Rock Creek, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
December	36	15.4	23.1	1,420	A.

SALMON FALLS RIVER DRAINAGE BASIN.

DESCRIPTION.

Salmon Falls River rises in the northern part of Elko County, Nev., flows in a general southerly direction for about 25 miles, then turns abruptly and flows irregularly northward to its junction with Snake River, near Austin, in the northwestern part of Twin Falls County, Idaho. From source to mouth the river is about 100 miles long.

SALMON FALLS RIVER AT SAN JACINTO, NEV.

This station, which is located about 7 miles north of the San Jacinto ranch and about 20 miles south (by road) of Salmon dam, was established September 17, 1909, to take the place of the station established earlier in the year at the Salmon dam site 15 miles below, as the latter station will soon be flooded out by backwater from the dam now under construction. The records of this new station give practically the same data as those obtained at the lower station.

Shoshone Creek enters the river just above the station and Cedar Creek about 30 miles below. The vertical staff gage is located on the right bank at the mouth of the canyon and about 350 feet downstream from the mouth of Shoshone Creek.

Low-water measurements can be made by wading. At present there is no cable equipment from which to make high-water measurements

The gage datum has remained unchanged since the station was established. No rating curve has yet been deduced from the observations.

Discharge measurements of Salmon Falls River at San Jacinto, Nev., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 17 [a]	W. M. O'Neill	34.5	21.2	0.93	42.5
17 [b]	do	16	11.6	.93	21.5

[a] Made by wading below Shoshone Creek. [b] Made by wading above Shoshone Creek.

NOTE.—Shoshone Creek was also measured September 17, 1909. The measured discharge was 16.1 second-feet. River gage read 0.93 foot. Total for river is 37.6 second-feet.

Daily gage height, in feet, of Salmon Falls River at San Jacinto, Nev., for 1909.

[Leonard Boyle, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	1.0	1.1	1.55	11	.....	1.05	1.15	1.45	21	.95	1.05	1.4	1.2
2	.....	1.0	1.1	1.45	12	.....	1.05	1.15	1.45	22	.95	1.1	1.45	1.2
3	.....	1.0	1.1	1.4	13	.....	1.05	1.2	1.4	23	.95	1.1	1.5	1.25
4	.....	1.0	1.1	1.25	14	.....	1.05	1.2	1.2	24	.95	1.1	1.5	1.25
5	.....	1.0	1.1	.....	15	.....	1.05	1.2	1.2	25	.95	1.1	1.6	.....
6	.....	1.0	1.1	1.3	16	.....	1.05	1.2	1.2	26	.95	1.1	.....	.....
7	.....	1.05	1.1	1.35	17	0.95	1.05	1.2	1.2	27	.95	1.1	1.6	1.2
8	.....	1.05	1.1	.....	18	.9	1.05	1.2	1.2	28	.9	1.1	1.6	1.2
9	.....	1.05	1.1	1.4	19	.95	1.05	1.25	1.2	29	1.00	1.1	1.5	1.2
10	.....	1.05	1.15	1.45	20	.95	1.05	1.3	1.2	30	1.00	1.1	1.5	.....
										31	.....	1.1	.....	.....

SALMON FALLS RIVER NEAR TWIN FALLS, IDAHO.

This station, which is located about 35 miles south of Twin Falls and about three-fourths of a mile upstream from the Salmon dam, was established May 31, 1909, to determine the amount of water available for storage in the Salmon Falls River reservoir now under construction.

Shoshone Creek enters the river about 15 miles above the station and Cedar Creek enters about 15 miles below.

The cable equipment from which measurements are made at ordinary and high stages is just upstream from the highway bridge on the road from Salmon dam to Cedar Creek. Low water measurements are made by wading. A vertical staff gage is located on the left bank about 15 feet upstream from the cable.

The records are affected by ice during the winter months but in 1909 were not affected by artificial control above or below. As soon as the Salmon dam is completed this station will be flooded out and the records must be discontinued.

The gage datum has remained unchanged since the station was established. A good rating curve has been obtained and the records during the open-water season may be considered excellent.

Discharge measurements of Salmon Falls River near Twin Falls, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 31	Wm. M. O'Neill	50.5	169	2.38	583
Sept. 16	do	43	42.4	− .10	34.4
18	do	36	23.8	− .12	36.6
Dec. 4	O. W. Hartwell	41	66.6	.28	66.9

Daily gage height, in feet, of Salmon Falls River near Twin Falls, Idaho, for 1909.

[T. R. Newell, observer.]

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.50	0.92	0.02	−0.16	0.02	0.10	0.38	16	1.96	0.32	−0.20	−0.06	0.05	0.28	0.50
2	2.44	.86	.00	− .08	.02	.10	.40	17	1.90	.28	− .20	− .06	.06	.30	.20
3	2.30	.82	.00	− .08	.02	.12	.24	18	1.86	.22	− .18	− .08	.06	.08	.54
4	2.28	.80	−.04	− .08	.02	.12	.28	19	1.76	.20	− .20	− .08	.06	.12	.20
5	2.44	.80	−.06	− .06	.02	.12	.18	20	1.76	.15	− .22	− .08	.08	.14	.30
6	2.60	.80	−.08	− .04	.02	.12	.30	21	1.92	.15	− .24	− .08	.08	.20	.42
7	2.74	.74	−.10	+ .02	.04	.12	.38	22	1.74	.12	− .25	− .06	.08	.24	.22
8	2.96	.68	−.10	+ .02	.04	.12	.52	23	1.60	.10	− .26	− .06	.08	.30	.12
9	3.00	.62	−.10	+ .02	.05	.14	.42	24	1.57	.10	− .25	− .06	.08	.42	.08
10	2.98	.56	−.10	.00	.05	.14	.48	25	1.45	.10	− .24	− .06	.08	.40	.08
11	2.80	.52	−.10	− .02	.05	.14	1.08	26	1.30	.08	− .24	− .06	.08	.50	.10
12	2.60	.48	−.12	− .04	.05	.14	.58	27	1.22	.08	− .25	− .06	.10	.52	.10
13	2.34	.44	−.14	− .04	.05	.16	.38	28	1.16	.10	− .26	− .06	.10	.47	.08
14	2.12	.39	−.16	− .04	.05	.16	.48	29	1.10	.10	− .28	− .04	.10	.42	.06
15	2.10	.36	−.18	− .04	.05	.20	.72	30	1.00	.06	− .28	.00	.10	.40	.04
								31	.....	.04	− .20	.....	.10	.....	.04

NOTE.—Ice from Nov. 21 to Dec. 31.

Daily discharge, in second-feet, of Salmon Falls River near Twin Falls, Idaho, for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	630	157	44	32	44	50	16	428	70	30	38	46*	66
2	605	146	42	37	44	50	17	408	66	30	38	47	68
3	550	139	42	37	44	52	18	395	60	31	37	47	48
4	542	135	40	37	44	52	19	364	58	30	37	47	52
5	605	135	38	38	44	52	20	364	54	29	37	48	53
6	672	135	37	40	44	52	21	415	54	28	37	48	50
7	731	125	36	44	45	52	22	358	52	27	38	48	50
8	823	116	36	44	45	52	23	316	50	26	38	48	50
9	840	108	36	44	46	53	24	308	50	27	38	48	50
10	832	100	36	42	46	53	25	275	50	28	38	48	50
11	756	95	36	41	46	53	26	236	48	28	38	48	50
12	672	90	35	40	46	53	27	217	48	27	38	50	50
13	565	85	34	40	46	55	28	203	50	26	38	50	50
14	483	79	32	40	46	55	29	190	50	25	40	50	50
15	476	75	31	40	46	58	30	171	47	25	42	50	50
							31	.....	45	30	.....	50	.....

NOTE.—These discharges are based on a rating curve fairly well defined below 600 second-feet. Discharges estimated Nov. 21 to 30 because of ice conditions.

Monthly discharge of Salmon Creek near Twin Falls, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	840	171	481	28,600	A.
July	157	45	83.0	5,100	A.
August	44	25	32.3	1,990	B.
September	44	32	38.9	2,310	B.
October	50	44	46.7	2,870	B.
November	68	48	52.6	3,130	B.
December			45.0	2,770	D.
The period				46,700	

NOTE.—Mean discharge estimated for December because of ice conditions.

CEDAR CREEK NEAR ROSEWORTH, IDAHO.

This station, which is located about 10 miles south of Roseworth, the nearest post office, about 25 miles south of Buhl, the nearest railway point, and about 7 miles west of Salmon dam, was established May 30, 1909, to determine the amount of water available for storage in connection with a Carey Act project on Cedar Creek.

Cedar Creek joins Salmon Falls River about 12 miles below the station. House Creek, the main source of supply, enters about 2½ miles above.

The gage is about 100 feet above the mouth of the West End Twin Falls Irrigation Co.'s tunnel and immediately upstream from the Cedar Creek dam site at Butte, and about 1 mile downstream from the mouth of the canyon.

Discharge measurements are made from a plank across the stream at the gage.

There is said to be some gain from seepage between this station and House Creek. When the Cedar Creek dam is completed this station will be flooded out by backwater and new stations will have to be established on Cedar Creek and House Creek above their junction.

The records are probably not seriously affected by ice, and during 1909 there was no effect from artificial control above or below.

Discharge measurements of Cedar Creek near Roseworth, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 30	Wm. M. O'Neill	12.5	33.2	2.92	41.0
Sept. 18	do	8.0	19.2	1.96	13.3
Dec. 2	O. W. Hartwell	13	23	2.35	20.4

Daily gage height, in feet, of Cedar Creek near Roseworth, Idaho, for 1909.

[W. H. Priest, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.8	2.05	2.0	2.0	2.0	.....	2.4
2	.....	.....	2.1	2.0	2.05	2.0	.....	2.4
3	.....	2.8	2.1	2.0	2.05	2.0	.....	2.2
4	.....	2.8	2.05	2.0	2.0	2.0	.....	2.0
5	.....	2.8	2.15	2.0	2.0	2.0	.....	2.1
6	.....	2.8	2.1	2.0	2.0	2.0	.....	2.1
7	.....	2.75	2.1	2.0	2.0	2.0	.....	2.15
8	.....	2.8	2.1	2.0	2.0	2.0	.....	2.2
9	.....	2.85	2.1	2.05	2.0	2.0	.....	2.15
10	.....	2.75	2.1	2.0	2.0	2.0	.....	2.15
11	.....	2.7	2.1	2.0	2.0	2.0	.....	2.15
12	.....	2.65	2.1	2.0	2.0	2.0	.....	2.3
13	.....	2.65	2.1	2.0	2.0	2.0	.....	2.3
14	.....	2.6	2.1	2.0	2.0	2.0	.....	2.25
15	.....	2.6	2.1	2.0	2.0	2.0	.....	2.2
16	.....	2.5	2.1	2.0	2.0	2.0	.....	2.15
17	.....	2.45	2.1	2.0	2.0	2.0	.....	2.1
18	.....	2.35	2.1	2.0	2.0	2.0	.....	2.1
19	.....	2.4	2.1	2.0	2.0	2.0	.....	2.1
20	.....	2.5	2.1	2.0	2.0	2.0	.....	2.1
21	.....	2.45	2.1	2.0	2.0	2.0	.....	2.0
22	.....	2.4	2.1	2.0	2.0	2.0	.....	2.0
23	.....	2.4	2.1	2.0	2.0	2.0	2.4	2.0
24	.....	2.3	2.1	2.0	2.0	.....	2.3	2.0
25	.....	2.2	2.05	2.0	2.0	.....	2.4	2.0
26	.....	2.15	2.0	2.0	2.0	.....	2.35	2.0
27	.....	2.1	2.05	2.0	2.0	.....	2.2	2.0
28	.....	2.1	2.05	2.0	2.0	.....	2.15	2.0
29	.....	2.1	2.05	2.0	2.0	.....	2.2	1.9
30	2.9	2.1	2.0	2.0	2.0	.....	2.4	1.9
31	2.85	.....	2.0	2.0	.....	.....	.....	2.0

Daily discharge, in second-feet, of Cedar Creek near Roseworth, Idaho, for 1909.

Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	36	14	13	13	13	16	22	16	26	15	13	13	13	20	16
2	36	15	13	14	13	16	22	17	24	15	13	13	13	20	15
3	36	15	13	14	13	16	18	18	21	15	13	13	13	21	15
4	36	14	13	13	13	17	13	19	22	15	13	13	13	21	15
5	36	16	13	13	13	17	15	20	26	15	13	13	13	21	15
6	36	15	13	13	13	17	15	21	24	15	13	13	13	21	13
7	34	15	13	13	13	18	16	22	22	15	13	13	13	22	13
8	36	15	13	13	13	18	18	23	22	15	13	13	13	22	13
9	38	15	14	13	13	18	16	24	20	15	13	13	14	20	13
10	34	15	13	13	13	19	16	25	18	14	13	13	14	22	13
11	32	15	13	13	13	19	16	26	16	13	13	13	14	21	13
12	30	15	13	13	13	19	20	27	15	14	13	13	15	18	13
13	30	15	13	13	13	19	20	28	15	14	13	13	15	16	13
14	28	15	13	13	13	20	19	29	15	14	13	13	15	18	11
15	28	15	13	13	13	20	18	30	15	13	13	13	15	22	11
								31	.....	13	13	.....	16	.....	13

NOTE.—These discharges are based on a rating curve that is fairly well defined.

Monthly discharge of Cedar Creek near Roseworth, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
June	36	15	26.9	1,600	B.
July	16	13	14.6	898	B.
August	14	13	13.0	799	B.
September	14	13	13.1	780	B.
October	16	13	13.4	824	B.
November	22	16	19.1	1,140	C.
December	22	11	15.4	947	B.
The period				6,990	

BIG WOOD RIVER NEAR SHOSHONE, IDAHO.

Big Wood (Malade) River rises near Galena Peak, in the northern part of Blaine County, Idaho, and flows southward and southwestward to its junction with Snake River in the western part of Lincoln County. It is about 100 miles long and drains an area of about 4,500 square miles in extent. It receives a number of tributaries, the most important being Camas Creek and Little Wood River.

This station, which was established June 5, 1905, discontinued December 31, 1906, and reestablished March 7, 1908, is located at A. D. Silva's ranch, 1 mile below the steel wagon bridge and 7 miles northwest of Shoshone, Idaho.

The records of this station show the total amount of water available for storage in the reservoir now under construction at the Cottonwoods, 15 miles above. The principal tributaries are Camas Creek, which enters about 26 miles above the station, and Little Wood River, entering about 15 miles below.

During the winter months the records are slightly affected by ice. They are not affected by artificial control below, but during the irrigating season practically the total flow of the river is diverted above. The gage datum has remained unchanged since the station was established.

The channel is permanent and a very good rating curve has been obtained. (See Pl. III, p. 26.)

Discharge measurements of Big Wood River near Shoshone, Idaho, for 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 21	W. M. O'Neill	93.5	549	7.22	2,490
Nov. 3	O'Neill and Hartwell	76	125	2.85	98

Daily gage height, in feet, of Big Wood River near Shoshone, Idaho, for 1909.

[A. D. Silva, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.6	2.7	2.6	4.2	5.95	6.4	6.0	2.3	2.9	2.7	2.8	3.8
2	2.6	2.7	2.7	4.5	5.7	6.7	6.0	2.2	2.2	2.7	2.85	3.75
3	2.55	2.8	2.7	4.7	5.55	7.3	6.0	2.0	2.5	2.8	2.85	3.65
4	2.55	2.9	2.7	5.2	5.6	7.3	6.0	2.0	2.55	2.8	2.8	3.5
5	2.6	2.9	2.85	5.15	6.0	7.5	6.0	2.2	2.6	2.85	2.8	3.5
6	2.55	3.0	2.85	4.95	6.4	7.3	6.0	2.1	2.7	2.9	2.9	3.45
7	2.55	2.7	2.75	4.95	6.3	7.3	5.6	2.0	2.75	3.0	2.9	3.4
8	2.6	2.7	2.8	5.2	6.2	7.4	5.2	1.7	2.8	3.0	2.9	3.4
9	2.65	2.65	2.8	5.4	6.2	7.5	5.0	2.1	2.8	3.0	2.9	3.45
10	2.6	2.6	2.8	5.8	6.1	7.2	4.8	2.05	2.8	2.95	2.9	3.45
11	2.6	2.6	2.7	6.8	6.0	6.8	4.6	2.05	2.8	2.9	2.95	3.4
12	2.6	2.8	2.6	7.65	5.9	6.5	4.4	2.0	2.7	2.85	2.95	3.25
13	2.6	3.1	2.65	8.0	5.8	6.3	4.2	2.0	2.75	2.8	2.95	3.3
14	2.7	3.5	3.0	8.75	5.7	6.0	4.2	2.0	2.8	2.8	2.9	3.35
15	3.0	3.1	3.1	8.75	5.7	5.9	4.1	1.95	2.8	2.8	2.8	3.4
16	3.7	2.7	3.4	8.75	5.7	6.2	3.8	1.9	2.75	2.75	2.65	3.35
17	4.2	3.0	3.5	8.95	5.65	6.7	3.8	1.9	2.65	2.8	2.5	3.3
18	6.2	3.4	3.15	8.95	5.6	7.2	3.75	1.85	2.65	2.7	2.4	3.3
19	4.75	3.2	3.2	8.15	5.4	7.2	3.7	1.8	2.7	2.7	3.0	3.25
20	4.9	3.2	3.0	7.5	5.3	6.9	3.7	1.8	2.7	2.75	3.05	3.25
21	5.35	3.2	2.8	7.4	5.45	6.8	3.7	1.75	2.65	2.75	3.15	3.25
22	4.3	3.3	2.8	6.95	5.4	6.6	3.3	1.7	2.65	2.75	3.2	3.25
23	3.7	3.35	3.25	6.4	5.6	6.4	3.0	1.7	2.65	2.7	3.3	3.2
24	3.6	3.4	3.5	6.3	5.9	6.3	2.9	1.65	2.7	2.8	3.8	3.2
25	3.5	3.5	3.3	6.0	5.8	6.2	2.7	.....	2.65	2.8	4.0	3.2
26	3.5	3.7	3.2	6.0	5.8	6.0	2.5	.....	2.65	2.8	4.5	3.2
27	3.4	3.1	3.2	6.05	6.4	5.9	2.55	.....	2.6	2.8	4.25	3.2
28	3.2	2.55	3.3	6.2	6.8	5.7	2.5	.....	2.6	2.75	4.2	3.0
29	3.0	.....	3.6	6.4	6.8	5.9	2.5	.....	2.65	2.75	4.0	2.9
30	2.75	.....	4.0	6.2	6.7	6.0	2.7	.....	2.65	2.75	3.8	2.85
31	2.75	.....	4.1	.....	6.4	.....	2.5	3.0	.....	2.7	.....	2.5

NOTE.—No ice notes reported.

Daily discharge, in second-feet, of Big Wood River near Shoshone, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	40	50	76	515	1,480	1,790	1,510	40	124	90	106	375
2	40	50	90	635	1,320	2,010	1,510	30	30	90	115	358
3	40	50	90	735	1,220	2,500	1,510	15	63	106	115	325
4	40	50	90	1,010	1,250	2,500	1,510	15	70	106	106	280
5	40	50	115	982	1,510	2,680	1,510	30	76	115	106	270
6	40	75	115	872	1,790	2,500	1,510	22	90	124	124	250
7	40	75	98	872	1,720	2,500	1,250	15	98	145	124	150
8	40	75	106	1,010	1,650	2,590	1,010	1	106	145	124	150
9	40	75	106	1,130	1,650	2,680	900	22	106	145	124	150
10	40	75	106	1,380	1,580	2,420	790	18	106	134	124	150
11	40	75	90	2,090	1,510	2,090	685	18	106	124	134	150
12	40	90	76	2,820	1,440	1,860	590	15	90	115	134	150
13	40	130	83	3,130	1,380	1,720	515	15	98	106	134	150
14	40	200	145	3,810	1,320	1,510	515	15	106	106	124	150
15	80	130	170	3,810	1,320	1,440	480	12	106	106	106	150
16	200	75	250	3,810	1,320	1,650	375	9	98	98	83	150
17	300	145	280	4,000	1,280	2,010	375	9	83	106	63	150
18	800	250	182	4,000	1,250	2,420	358	6.5	83	90	51	150
19	760	195	195	3,260	1,130	2,420	340	4	90	90	145	150
20	845	195	145	2,680	1,070	2,170	340	4	90	98	158	150
21	1,090	195	106	2,590	1,160	2,090	340	2.5	83	98	182	150
22	550	220	106	2,210	1,130	1,940	220	1	83	98	195	150
23	310	235	208	1,790	1,250	1,790	145	1	83	90	220	150
24	310	250	280	1,720	1,440	1,720	124	.5	90	106	375	150
25	280	280	220	1,510	1,380	1,650	90	0	83	106	445	150
26	270	340	195	1,510	1,380	1,510	63	0	83	106	635	150
27	230	170	195	1,540	1,790	1,440	70	0	76	106	532	150
28	200	70	220	1,650	2,090	1,320	63	0	76	98	515	150
29	150	.....	310	1,790	2,090	1,440	63	0	83	98	445	150
30	100	.....	445	1,650	2,010	1,510	90	0	83	98	375	150
31	50	.....	480	.....	1,790	.....	63	145	.....	90	.....	150

NOTE.—These discharges are based on a rating curve that is well defined between 40 and 2,680 second-feet.

Monthly discharge of Big Wood River near Shoshone, Idaho, for 1909.

[Drainage area, 1,780 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	1,090	40	230	0.129	0.15	14,100	B.
February	340	50	138	.078	.08	7,660	B.
March	480	76	173	.097	.11	10,600	A.
April	4,000	515	2,020	1.13	1.26	120,000	A.
May	2,090	1,070	1,470	.826	.95	90,400	A.
June	2,680	1,320	2,000	1.12	1.25	119,600	A.
July	1,510	63	610	.343	.40	37,500	A.
August	145	0	15.0	.0084	.01	922	B.
September	124	30	88.1	.050	.06	5,240	B.
October	145	90	108	.061	.07	6,640	A.
November	635	51	207	.116	.13	12,300	A.
December	375	150	181	.102	.12	11,100	B.
The year	4,000	0	603	.338	4.59	435,000	

LITTLE CANYON CREEK AT GLENNS FERRY, IDAHO.

Little Canyon Creek, a stream about 20 miles long, joins Snake River from the north at Glenns Ferry.

The gaging, which is located in the western part of the town of Glenns Ferry, Idaho, at the highway bridge on the road from Glenns Ferry to Hammett, just above the point at which the creek crosses the tracks of the Oregon Short Line Railroad, was established November 20, 1909, to determine the amount of water available for the irrigation of Carey Act lands.

The staff gage is attached to the bridge, from which discharge measurements are made at high stages. Measurements at low water are made by wading.

The records of this station show the total discharge of the creek into Snake River. No rating has yet been obtained.

Daily gage height, in feet, of Little Canyon Creek at Glenns Ferry, Idaho, for 1909.

[R. C. Gossett, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		1.2	11		1.7	21	2.2	1.5
2		1.2	12		1.7	22	3.6	1.0
3		1.2	13		1.7	23	3.6	1.0
4		1.6	14		1.7	24	2.5	1.0
5		2.0	15		1.5	25	2.2	1.0
6		1.9	16		1.3	26	2.2	.8
7		1.8	17		1.3	27	2.1	.8
8		1.7	18		1.3	28	2.0	.8
9		1.8	19		1.4	29	1.9	.8
10		1.9	20	1.0	1.5	30	1.9	1.3
						31		1.0

ALKALI CREEK NEAR GLENNS FERRY, IDAHO.

Alkali Creek, a stream about 12 miles long, rises in the southern part of Elmore County and flows southward into Snake River about 4 miles west of Glenns Falls.

The gaging station, which is located about 200 yards above the ford on the road from Glenns Ferry to Hammett, and a short distance above the point at which the creek crosses the tracks of the Oregon Short Line Railroad, was established November 20, 1909, to determine the amount of water available for irrigation of Carey Act lands.

The staff gage is placed on the right bank. Discharge measurements are made by wading.

The records at this station show the total discharge from the Alkali Creek drainage into Snake River. No rating curve has yet been developed.

Daily gage height, in feet, of Alkali Creek near Glenns Ferry, Idaho, for 1909.

[R. C. Gossett, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		1.5	11		1.6	21	3.6	0.1
2		1.5	12		1.4	22	3.4	.1
3		1.6	13		1.0	23	3.0	.1
4		1.4	14		.6	24	3.6	.1
5		1.2	15		.4	25	3.7	.1
6		1.4	16		.2	26	3.6	.1
7		1.5	17		.2	27	3.2	.1
8		1.4	18		.2	28	2.4	.1
9		1.9	19		.2	29	1.5	.1
10		1.8	20	3.7	.1	30	1.5	.2
						31		.1

COLD SPRING CREEK NEAR MEDBURY, IDAHO.

Cold Spring Creek, a stream about 25 miles long, joins Snake River from the north in the southern part of Elmira County, about 8 miles west of Glenns Falls.

The gaging station, which is located at the highway bridge on the road from Hammett railroad station, just north of the tracks of the Oregon Short Line Railroad and about 3 miles east of Medbury, Idaho, was established November 20, 1909, to determine the amount of water available for irrigation on Carey Act lands.

The records show the total discharge into Snake River from the Cold Spring Creek drainage.

The gage is nailed to the bridge, from which discharge measurements are made, except during low water, when they are made by wading. No rating curve has yet been developed.

Daily gage height, in feet, of Cold Spring Creek near Medbury, Idaho, for 1909.

[R. C. Gossett, observer.]

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1		0.7	11		0.7	21	0.4	0.2
2		.5	12		.6	22	1.6	.1
3		.5	13		.6	23	1.6	.1
4		.5	14		.45	24	1.7	.1
5		.5	15		.3	25	1.7	.2
6		.5	16		.2	26	1.6	.2
7		.5	17		.2	27	1.4	.1
8		.5	18		.2	28	1.0	.1
9		.8	19		.2	29	.8	.1
10		.9	20	0.4	.2	30	.7	.3
						31		.2

BENNETT CREEK NEAR MEDBURY, IDAHO.

Bennett Creek rises in the southern part of Elmira County and flows southward into Snake River about 12 miles west of Glenns Falls. It is about 25 miles long.

The gaging station, which is located at the highway bridge, about 2 miles west of Medbury, Idaho (Hammett railroad station), and about one-half mile north of the tracks of the Oregon Short Line Railroad, was established November 20, 1909, to determine the amount of water available for irrigation of Carey Act lands.

The records show the total discharge into Snake River from the Bennett Creek drainage.

The staff gage is attached to the bridge, from which discharge measurements are made at medium and high stages. Measurements at low water are made by wading.

The following discharge measurement was made by O. W. Hartwell:

December 14, 1909: Width, 20 feet; area, 18.8 square feet; gage height, 0.80 foot; discharge, 30.7 second-feet.

Daily gage height, in feet, and daily discharge, in second-feet, of Bennett Creek near Medbury, Idaho, for 1909.

[R. C. Gossett, observer.]

Day.	November.		December.		Day.	November.		December.	
	Gage height.	Discharge.	Gage height.	Discharge.		Gage height.	Discharge.	Gage height.	Discharge.
1			1.2	56	16			0.7	23
2			1.2	56	17			.5	15
3			1.3	63	18			.5	15
4			1.4	70	19			.5	15
5			1.4	70	20	1.2	56	.3	9
6			1.4	70	21	1.2	56	.3	9
7			1.4	70	22	3.4	256	.4	11
8			1.4	70	23	3.4	256	.4	11
9			1.4	70	24	3.2	234	.4	11
10			1.6	84	25	3.0	212	.4	11
11			1.4	70	26	2.4	152	.3	9
12			1.2	56	27	2.1	125	.3	9
13			1.2	56	28	1.8	100	.3	9
14			.8	28	29	1.4	70	.3	9
15			.8	28	30	1.3	63	.5	15
					31			.3	9

NOTE.—The daily discharges are based on a well-defined rating curve.

Monthly discharge of Bennett Creek near Medbury, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
November 20–30	256	56	144	3,140	A.
December	84	9	35.7	2,200	A.

BRUNEAU RIVER DRAINAGE BASIN.

DESCRIPTION.

Bruneau River rises in northern Nevada, flows in a general northerly direction, and enters Snake River in Owyhee County, Idaho. Its basin is of a rolling character and is devoted to stock raising. Systematic measurements on this river have been maintained by Andrew J. Wiley for the Owyhee Land & Irrigation Co., immediately below the headworks of its canal system, 10 miles east of Grandview, Idaho.

BRUNEAU RIVER NEAR HOT SPRING, IDAHO.

This station, which was established July 3, 1909, to determine the amount of water available for storage in connection with irrigation on the Bruneau tract, is located at Dunham's ranch, about 2 miles upstream from the Hot Spring post office.

The principal tributaries above are West Fork, which enters the Bruneau about 35 miles upstream; East Fork, which comes in about 15 miles above; and Hot Creek, which is tributary about one-half mile above the station. No important tributaries enter the river between the station and Snake River, about 20 miles below.

The vertical staff gage is located about one-fourth mile above Dunham's farmhouse on the right bank and about 600 feet below the cable station.

The records are not affected by ice or by artificial control above or below. The gage datum has remained unchanged since the station was established.

Discharge measurements of Bruneau River near Hot Spring, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 22	Wm. M. O'Neill	42	43	2.02	109
Oct. 4	do	40.8	44.8	2.12	115
Nov. 9	O'Neill and Hartwell	84	73.2	2.20	134

Daily gage height, in feet, of Bruneau River near Hot Spring, Idaho, for 1909.

[W. N. Dunham, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.3	2.1	2.1	2.1	2.7	16	2.9	2.0	2.2	2.1	.....	2.6
2	.....	2.25	2.1	2.0	2.1	2.9	17	2.9	2.0	2.2	2.1	2.15	2.5
3	4.1	2.25	2.1	2.0	2.1	2.7	18	2.9	2.0	2.1	2.1	2.1	2.4
4	4.0	2.2	2.1	2.1	2.1	3.0	19	2.8	2.0	2.0	2.1	2.0	2.1
5	3.9	2.3	2.3	2.1	2.1	2.9	20	2.7	2.0	2.0	2.1	2.0	2.5
6	3.9	2.1	2.6	2.2	2.2	2.6	21	2.65	2.0	2.0	2.1	2.2	2.1
7	3.7	2.1	2.3	2.2	2.2	2.5	22	2.5	1.9	2.0	2.1	2.2	2.0
8	3.5	2.15	2.3	2.1	2.2	2.5	23	2.5	1.9	2.0	2.1	2.3	2.0
9	3.4	2.1	2.3	2.2	2.2	2.6	24	2.55	1.9	2.0	2.1	3.0	2.1
10	3.15	2.1	2.1	2.2	2.2	2.7	25	2.5	1.9	2.0	2.1	3.7	2.0
11	3.15	2.1	2.1	2.1	2.2	2.7	26	2.5	1.9	2.0	2.1	3.8	2.1
12	3.1	2.1	2.1	2.1	.....	2.7	27	2.5	1.9	2.0	2.1	3.4	2.1
13	3.0	2.1	2.1	2.1	2.2	2.6	28	2.5	1.9	2.0	2.1	3.1	2.2
14	3.0	2.05	2.1	2.1	2.2	2.4	29	2.55	1.9	2.0	2.1	3.3	2.3
15	2.9	2.0	2.2	2.1	2.2	2.7	30	2.45	1.9	2.1	2.1	3.0	2.2
							31	2.35	1.9	.....	2.1	.....	2.1

Daily discharge, in second-feet, of Bruneau River near Hot Spring, Idaho, for 1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	170	115	115	115	314	16	402	94	140	115	131	274
2	.....	155	115	94	115	402	17	402	94	140	115	128	236
3	1110	155	115	94	115	314	18	402	94	115	115	115	202
4	1050	140	115	115	115	450	19	356	94	94	115	94	115
5	982	170	170	115	115	402	20	314	94	94	115	94	236
6	982	115	274	140	140	274	21	294	94	94	115	140	115
7	852	115	170	140	140	236	22	236	77	94	115	140	94
8	730	128	170	115	140	236	23	236	77	94	115	170	94
9	670	115	170	140	140	274	24	255	77	94	115	450	115
10	527	115	115	140	140	314	25	236	77	94	115	852	94
11	527	115	115	115	140	314	26	236	77	94	115	916	115
12	500	115	115	115	140	314	27	236	77	94	115	670	115
13	450	115	115	115	140	274	28	236	77	94	115	500	140
14	450	104	115	115	140	202	29	255	77	94	115	610	170
15	402	94	140	115	140	314	30	219	77	115	115	450	140
							31	186	77	.....	115	.....	115

NOTE.—These discharges are based on a rating curve that is well defined between discharges of 50 and 300 second-feet.

Monthly discharge of Bruneau River near Hot Spring, Idaho, for July–December, 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
July 3–31	1,110	186	474	27,300	B.
August	170	77	105	6,460	A.
September	274	94	122	7,260	A.
October	140	94	117	7,190	A.
November	916	94	248	14,800	A.
December	450	94	226	13,900	A.
The period	.....	.....	.....	76,900	

BRUNEAU RIVER NEAR GRANDVIEW, IDAHO.

This station, which was established May 1, 1909, to determine the amount of water wasting into Snake River over the Bruneau dam, is located about one-fourth mile below the headworks of the Owyhee Land and Irrigation Co.'s canal system, where a station was maintained from 1895 to 1903. It is 10 miles east of Grandview and about 8 miles west of Bruneau, Idaho.

The gage installed in 1895 was used until March 6, 1903, when a new staff gage was set at the same datum, 25 feet upstream on the left bank, at the ford on the old stage road about 1 mile above the mouth of the river. On May 1, 1909, readings on this gage were resumed and continued until November 6, 1909, when a new vertical staff gage was installed at the same datum about 46 feet upstream on the left bank.

High-water measurements are made from a boat and stayline attachment. Low-water measurements can be made by wading about 300 feet downstream from the gage.

As no record has been kept of the water diverted by the canal system, the discharge as measured at this station does not show the run-off from the drainage area above the station. The capacity of the canal system is about 540 second-feet.

The records will probably not be seriously affected by ice but will be affected by changes in the gates on the dam above.

Discharge measurements of Bruneau River near Grandview, Idaho, in 1909.

Date.	Hydrographers.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 21 [a]	Wm. M. O'Neill			1.20	66.3
Oct. 4 [a]	do			1.40	127
Nov. 6	O'Neill and Hartwell	106	160	1.41	117

[a] Made by wading about 600 feet below the gage.

Daily gage height, in feet, of Bruneau River near Grandview, Idaho, for 1909.

[C. C. Gregg, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	3.65	2.7	1.35	0.8	1.4	1.4	1.9
2	3.1	3.8	2.6	1.35	1.3	1.35	1.4	1.9
3	3.05	4.1	2.55	1.3	1.3	1.4	1.4	2.0
4	3.1	4.4	2.5	1.3	1.2	1.4	1.4	1.9
5	3.2	4.6	2.45	1.25	1.4	1.4	1.4	1.8
6	3.7	4.6	2.4	1.2	1.5	1.4	1.4	1.8
7	3.9	4.5	2.25	1.2	1.6	1.4	1.4	1.2
8	3.8	4.4	2.15	1.2	1.5	1.45	1.4	1.2
9	3.7	4.2	2.05	1.15	1.5	1.45	1.45	2.0
10	3.7	4.0	2.0	1.15	1.5	1.41	1.5	2.0
11	3.7	3.6	1.9	1.1	1.45	1.4	1.5	1.9
12	3.6	3.4	1.85	1.0	1.4	1.4	1.5	1.8
13	3.5	3.3	1.85	1.0	1.4	1.4	1.5	1.7
14	3.4	3.35	1.85	1.0	1.3	1.4	1.45	1.7
15	3.2	3.5	1.75	1.0	1.3	1.4	1.5	1.7

Daily gage height, in feet, of Bruneau River near Grandview, Idaho, for 1909—Continued.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	3.1	3.6	1.7	.9	1.3	1.4	1.5	1.65
17	3.1	3.6	1.65	.9	1.25	1.35	1.4	1.5
18	3.2	3.5	1.6	.9	1.25	1.35	1.45	1.5
19	3.2	3.5	1.55	.9	1.2	1.35	1.5	1.5
20	3.2	3.45	1.55	.9	1.2	1.35	1.5	1.5
21	3.1	3.25	1.5	.9	1.2	1.35	1.6	1.5
22	3.15	3.2	1.5	.9	1.2	1.35	2.0	1.5
23	3.15	3.1	1.4	.9	1.2	1.35	2.1	1.45
24	3.45	3.1	1.4	.9	1.25	1.35	2.1	1.45
25	3.4	3.0	1.35	.9	1.2	1.35	2.2	1.5
26	3.3	3.0	1.3	.9	1.35	1.4	2.1	1.5
27	3.4	2.9	1.3	.9	1.4	1.4	2.2	1.55
28	3.5	2.9	1.3	.9	1.4	1.4	2.2	1.6
29	3.9	2.8	1.3	.8	1.4	1.4	2.2	1.6
30	4.0	2.75	1.3	.8	1.4	1.35	1.9	1.6
31	3.8	.....	1.3	.8	.....	1.35	.....	1.6

Daily discharge, in second-feet, of Bruneau River near Grandview, Idaho, for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1160	1400	760	101	12	114	114	300
2	1020	1510	696	101	88	101	114	300
3	990	1720	665	88	88	114	114	350
4	1020	1930	634	88	66	114	114	300
5	1090	2070	604	77	114	114	114	255
6	1440	2070	574	66	144	114	114	255
7	1580	2000	485	66	177	114	114	66
8	1510	1930	429	66	144	129	114	66
9	1440	1790	376	56	144	129	129	350
10	1440	1650	350	56	144	114	144	350
11	1440	1370	300	47	129	114	144	300
12	1370	1230	278	32	114	114	144	255
13	1300	1160	278	32	114	114	144	214
14	1230	1200	278	32	88	114	129	214
15	1090	1300	234	32	88	114	144	214
16	1020	1370	214	20	88	114	144	196
17	1020	1370	196	20	77	101	114	144
18	1090	1300	177	20	77	101	129	144
19	1090	1300	160	20	66	101	144	144
20	1090	1260	160	20	66	101	144	144
21	1020	1130	144	20	66	101	177	144
22	1060	1090	144	20	66	101	350	144
23	1060	1020	114	20	66	101	402	129
24	1260	1020	114	20	77	101	402	129
25	1230	956	101	20	66	101	456	144
26	1160	956	88	20	101	114	402	144
27	1230	890	88	20	114	114	456	160
28	1300	890	88	20	114	114	456	177
29	1580	824	88	12	114	114	456	177
30	1650	792	88	12	114	101	300	177
31	1510	.....	88	12	.....	101	.....	177

Monthly discharge of Bruneau River near Grandview, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
May	1,650	990	1,240	76,200	B.
June	2,070	792	1,350	80,300	B.
July	760	88	290	17,800	A.
August	101	12	39.9	2,450	B.
September	177	12	97.5	5,800	A.
October	129	101	110	6,760	A.
November	456	114	214	12,700	A.
December	350	66	202	12,400	A.
The period	.....	.....	.....	214,000	

NOTE—These discharges are based on a rating curve that is well defined between 50 and 300 second-feet.

SUCCOR CREEK NEAR HOMEDALE, IDAHO.

Succor Creek rises in the Mahogany Mountains, in the eastern part of Malheur County, Oreg., flows northeastward, and joins Snake River near Homedale, Idaho.

This gaging station, which was established March 19, 1903, in order to determine the amount of water which wastes annually into Snake River, was originally located at a small truss bridge built to carry a flume, about half a mile above the mouth of the creek. It has been moved twice, the second time on August 28, 1907, when the cable was moved about one-fourth mile downstream. On January 24, 1908, a new chain gage was installed at a point about 200 feet above the cable. This gage was washed out January 20, 1909, but was replaced on January 23, 1909, by a new staff gage with the same datum.

The station is below all tributaries and diversion canals. The entire low water flow is diverted for irrigation purposes above.

Discharge measurements of Succor Creek near Homedale, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 15	E. C. La Rue	67	39.4	2.40	147
Apr. 23	do	42	24.7	2.10	96.7
Sept. 30	W. M. O'Neill	2.0	.39	1.15	.24

Daily gage height, in feet, of Succor Creek near Homedale, Idaho, for 1909.

[Mrs. Minnie Tracy, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.7	2.0	2.2	2.5	2.0	1.6	1.3	0.9	0.95	1.1	1.12	1.16
2	1.7	2.0	2.3	2.5	1.9	1.6	1.2	.9	1.3	1.15	1.12	1.16
3	1.7	2.0	2.3	2.55	2.0	1.6	1.0	.9	1.3	1.15	1.14	1.17
4	1.7	1.9	2.4	2.4	2.0	1.55	1.1	.95	.9	1.15	1.15	1.17
5	2.3	1.9	2.3	2.3	2.0	1.5	1.1	.95	.95	1.15	1.15	1.17
6	2.0	1.9	2.2	2.25	2.0	1.5	1.1	.95	.95	1.15	1.14	1.15
7	2.75	1.9	2.4	2.1	2.0	1.45	1.1	.95	1.0	1.25	1.14	1.15
8	2.75	1.85	2.3	2.1	2.0	1.45	1.05	.95	1.0	1.2	1.15	1.18
9	1.9	1.85	2.2	2.1	1.9	1.45	1.05	.95	1.0	1.18	1.14	1.19
10	1.8	1.85	2.2	2.0	1.9	1.45	1.0	.95	.95	1.15	1.15	1.20
11	1.7	1.85	2.2	2.0	1.9	1.45	1.0	.95	.95	1.15	1.15	1.19
12	1.7	2.85	2.2	2.1	1.85	1.45	.95	.95	.95	1.18	1.14	1.19
13	1.7	2.7	2.1	2.1	1.8	.....	.95	.95	.95	1.17	1.15	1.19
14	1.7	2.6	2.2	2.2	1.8	.....	.9	.95	1.0	1.15	1.15	1.18
15	4.85	2.3	2.4	2.25	1.8	.....	.9	.95	1.1	1.15	1.13	1.18
16	4.6	2.3	.2.7	2.3	1.8	.....	.9	.95	1.1	1.15	1.13	1.17
17	3.65	4.0	2.7	2.3	1.8	1.5	.9	.95	1.05	1.15	1.15	1.17
18	3.4	2.6	2.6	2.3	1.75	1.5	.95	.95	1.05	1.15	1.15	1.17
19	3.6	2.5	2.5	2.25	1.7	1.45	1.0	.95	1.05	1.14	1.15	1.18
20	.....	2.3	2.3	2.2	1.6	1.8	1.0	.95	.9	1.13	1.14	1.18
21	.....	2.3	2.2	2.2	1.6	1.9	1.0	.95	.95	1.13	1.15	1.18
22	.....	2.2	2.3	2.15	1.8	1.6	1.0	.95	1.0	1.15	1.16	1.18
23	2.9	2.2	2.3	2.1	1.7	1.5	1.0	.95	1.1	1.15	1.19	1.18
24	2.9	2.2	2.4	2.1	1.65	.....	.95	.95	1.1	1.14	1.17	1.18
25	2.8	2.2	2.5	2.1	1.6	.....	.95	.95	1.1	1.14	1.18	1.18
26	2.75	2.2	2.6	2.1	1.6	.....	.95	.95	1.1	1.14	1.18	1.18
27	2.7	2.2	2.6	2.05	1.55	.....	.9	.95	1.1	1.13	1.19	1.18
28	2.6	2.2	2.6	2.0	1.7	.....	.9	.95	1.1	1.12	1.16	1.18
29	2.4	.....	2.6	2.0	1.7	1.6	.9	.95	1.1	1.12	1.15	1.18
30	2.3	.....	2.6	2.0	1.65	1.5	.9	.95	1.1	1.13	1.15	1.18
31	2.2	.....	2.5	.....	1.65	.....	.9	.95	.....	1.15	.....	1.18

NOTE.—Ice conditions from about Dec. 19 to 31.

Daily discharge, in second-feet, of Succor Creek near Homedale, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	82	81	113	165	81	31	7.2	.....	0	0	0.1	0.3
2	82	81	130	165	67	31	1.8	.....	7.2	.2	.1	.3
3	82	81	130	174	81	31	0	.....	7.2	.2	.2	.6
4	82	67	147	147	81	26	0	.....	0	.2	.2	.6
5	196	67	130	130	81	22	0	.....	0	.2	.2	.6
6	136	67	113	122	81	22	0	.....	0	.2	.2	.2
7	286	67	147	97	81	17.7	0	.....	0	4.5	.2	.2
8	326	60	130	97	81	17.7	0	.....	0	1.8	.2	1.0
9	118	60	113	97	67	17.7	0	.....	0	1.0	.2	1.4
10	100	60	113	81	67	17.7	0	.....	0	.2	.2	1.8
11	82	60	113	81	67	17.7	0	.....	0	.2	.2	1.4
12	82	232	113	97	60	17.7	0	.....	9	1.0	.2	1.4
13	82	203	97	97	54	18.5	0	.....	0	.6	.2	1.4
14	82	184	113	113	54	19.3	0	.....	0	.2	.2	1.0
15	706	130	147	122	54	20	0	.....	0	.2	.1	1.0
16	628	130	203	130	54	21	0	.....	0	.2	.1	.6
17	402	484	203	130	54	22	0	.....	0	.2	.2	.6
18	346	184	184	130	48	22	0	.....	0	.2	.2	.6
19	391	165	165	122	41	17.7	0	.....	0	.2	.2	.5
20	353	130	130	113	31	54	0	.....	0	.1	.2	.5
21	315	130	113	113	31	67	0	.....	0	.1	.2	.5
22	278	113	130	105	54	31	0	.....	0	.2	.3	.5
23	241	113	130	97	41	22	0	.....	0	.2	1.4	.5
24	241	113	147	97	36	24	0	.....	0	.2	.6	.5
25	222	113	165	97	31	25	0	.....	0	.2	1.0	.5
26	212	113	184	97	31	26	0	.....	0	.2	1.0	.5
27	203	113	184	89	26	28	0	.....	0	.1	1.4	.5
28	184	113	184	81	41	30	0	.....	0	.1	.3	.5
29	147	.....	184	81	41	31	0	.....	0	.1	.2	.5
30	130	.....	184	81	36	22	0	.....	0	.1	.2	.5
31	113	.....	165	.....	36	.....	0	.....	.....	.2	.....	.5

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to 15, not well defined; Jan. 16 to Dec. 18, fairly well defined below 200 second feet; Dec. 19 to 31, discharge estimated because of ice conditions. Discharges interpolated for days having no gage record.

Monthly discharge of Succor Creek near Homedale, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	706	82	224	13,800	D.
February	484	60	126	7,000	D.
March	203	97	145	8,920	C.
April	174	81	112	6,660	C.
May	81	26	54.5	3,350	C.
June	67	17.7	25.7	1,530	D.
July	7.2	0	.29	17.8	D.
August	0	0	.0	0	D.
September	7.2	0	.48	28.6	D.
October	4.5	0	.43	26.4	D.
November	1.4	0.1	.34	20.2	D.
December	1.8	0.2	.69	42.4	D.
The year	706	0	57.5	41,400	

OWYHEE RIVER DRAINAGE BASIN.

DESCRIPTION.

Owyhee River rises in the Independence National Forest in the north-central portion of Nevada, flows north, then northwest across the corner of Idaho and into Oregon, where it turns abruptly and flows northeastward to its junction with Snake River, near Nyssa, Oreg., opposite the mouth of Boise River in Idaho. The total

length of the river is about 220 miles, and the drainage area comprises 11,100 square miles.

The country drained is an exceedingly arid desert, the annual precipitation ranging from 6 to 9 inches, the larger part occurring as snowfall. Forests are entirely lacking except on the extreme headwaters, and even there they are small. The general elevation of the river basin is about 4,000 feet, and the altitudes have but little effect on the precipitation. The streams are frequently frozen for considerable periods during the winter months, so that records for this part of the year are subject to inaccuracies. The low-water flow of this stream at the mouth is nearly all taken by a large canal for the irrigation of lands lying between Owyhee and Malheur rivers. On the upper stretches of the river conditions are favorable for impounding the flood and winter flows for irrigation during the summer months.

OWYHEE RIVER AT OWYHEE, OREG.

This station, which was established March 26, 1890, discontinued October 3, 1896, and reestablished August 27, 1903, is located at the county bridge half a mile from Owyhee post office and 3 miles above the mouth of the stream.

The data have practical value in connection with irrigation development.

The Owyhee ditch diverts water 6 miles above the gaging station. A record of the flow of this canal was kept during the irrigating season of 1905 at a point 2 miles below the intake. The maximum diversion during this period was 210 second-feet, in June. There are five wasteways on this canal, the first two being above the gaging station. The natural flow of the river at this point must therefore be obtained by adding the diversion in the canal to the flow obtained at the river gaging station, and subtracting from this sum the amount returning from the first two waste ways.

The entire low-water flow is diverted for irrigation and the flow measured at this point at such times is only seepage water.

During the winter months the gage heights are somewhat affected by ice, but the periods during which the stream is ice-bound are short, and even at such times approximate records can be obtained. The datum of the gage has not been changed since its installation in 1903.

No discharge measurements were made during 1909.

This station was last inspected May 28, 1908. The accuracy of the daily and monthly discharges given below is, therefore, dependent upon the permanency of conditions of flow and of the elevation of the gage since that date. As the flow is controlled by a riffle 200 yards below the station and measuring conditions are favorable for good results, the records are believed to be reliable.

Daily gage height, in feet, of Owyhee River at Owyhee, Oreg., for 1909.

[Gilder Watson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.5	4.75	4.2	6.6	6.05	4.95	3.17	2.22	2.15	2.15	2.5	4.0
2	3.45	4.65	4.15	6.55	6.1	4.95	3.12	2.2	2.15	2.2	2.5	3.95
3	3.5	4.55	4.2	6.65	6.05	4.9	3.05	2.2	3.61	2.25	2.5	3.9
4	3.5	4.5	4.3	6.9	6.0	4.9	3.0	2.2	2.4	2.3	2.5	3.8
5	3.5	4.4	4.6	7.0	5.9	4.9	2.95	2.2	2.35	2.3	2.5	3.65
6	3.5	4.35	5.28	6.7	5.8	4.85	2.95	2.2	2.3	2.3	2.5	3.6
7	3.7	4.25	5.3	6.4	5.7	4.82	2.9	2.2	2.22	2.3	2.5	3.6
8	5.5	4.2	5.05	6.0	5.8	4.8	2.9	2.2	2.2	2.35	2.5	3.6
9	5.7	4.15	4.95	5.85	5.8	4.78	2.8	2.15	2.18	2.35	2.5	3.6
10	5.25	4.0	4.9	5.65	5.75	4.7	2.8	2.15	2.16	2.35	2.5	3.6
11	5.0	3.85	4.85	.98	55.7	4.65	2.75	2.15	2.15	2.38	2.5	3.6
12	4.85	4.0	4.8	6.5	5.65	4.6	2.72	2.15	2.15	2.38	2.5	3.6
13	4.7	4.0	4.6	6.3	5.6	4.5	2.7	2.15	2.15	2.4	2.5	3.6
14	4.7	4.15	4.5	6.3	5.52	4.38	2.68	2.15	2.15	2.4	2.5	3.6
15	5.3	4.25	4.4	6.7	5.45	4.3	2.68	2.15	2.15	2.42	2.5	3.6
16	7.82	4.4	4.5	7.0	5.35	4.22	2.65	2.15	2.15	2.42	2.5	3.6
17	10.0	5.1	5.25	6.9	5.15	4.15	2.62	2.15	2.15	2.45	2.5	3.6
18	9.7	4.75	6.68	6.9	5.1	4.1	2.6	2.15	2.15	2.45	2.5	3.6
19	8.55	5.2	6.7	6.9	5.0	4.05	2.55	2.15	2.15	2.45	2.5	3.6
20	8.9	5.9	6.45	6.85	5.0	4.0	2.55	2.15	2.15	2.45	2.55	3.6
21	9.6	5.3	5.95	6.6	5.0	3.95	2.5	2.15	2.15	2.45	2.6	3.6
22	8.68	5.0	6.8	6.45	4.95	3.87	2.45	2.15	2.15	2.45	2.6	3.6
23	8.25	4.75	6.55	6.35	4.9	3.75	2.4	2.15	2.15	2.45	3.7	3.6
24	7.25	4.6	6.4	6.75	5.0	3.67	2.38	2.15	2.15	2.45	4.68	3.6
25	6.62	4.4	6.3	6.1	5.1	3.6	2.35	2.15	2.15	2.45	5.1	3.6
26	6.3	4.3	6.2	6.0	5.1	3.53	2.3	2.15	2.15	2.45	4.68	3.6
27	5.9	4.25	6.0	6.0	5.0	3.5	2.3	2.15	2.15	2.5	4.45	3.6
28	5.7	4.2	5.9	5.95	5.0	3.45	2.28	2.15	2.15	2.5	4.35	3.6
29	5.5	.....	6.05	5.95	4.9	3.38	2.25	2.15	2.15	2.5	4.2	3.6
30	5.35	.....	6.4	6.0	5.0	3.3	2.25	2.15	2.15	2.5	4.1	3.6
31	5.0	.....	6.6	.....	5.0	.....	2.22	2.15	.....	2.5	.....	3.6

NOTE.—No ice notes reported for January. The gage heights for Jan. 1 to 7 may be slightly affected by ice conditions. Ice conditions from about Dec. 12 to 31: River reported one-fourth frozen over Dec. 12, one-half frozen over Dec. 25, and entirely closed Dec. 31.

Daily discharge, in second-feet, of Owyhee River at Owyhee, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	680	1,900	1,270	5,220	4,060	2,170	456	54	42	42	125	1,080
2	645	1,770	1,220	5,110	4,160	2,170	423	50	42	50	125	1,040
3	680	1,650	1,270	5,340	4,060	2,100	380	50	762	60	125	995
4	680	1,590	1,370	5,920	3,960	2,100	350	50	95	70	125	910
5	680	1,480	1,710	6,160	3,770	2,100	322	50	82	70	125	792
6	680	1,420	2,670	5,450	3,580	2,030	322	50	70	70	125	755
7	830	1,320	2,700	4,780	3,390	1,990	295	50	54	70	125	755
8	3,120	1,270	2,320	3,960	3,580	1,960	295	50	50	82	125	755
9	3,390	1,220	2,170	3,680	3,580	1,930	245	42	47	82	125	755
10	2,620	1,080	2,100	3,300	3,480	1,830	245	42	44	82	125	755
11	2,240	952	2,030	3,920	3,390	1,770	222	42	42	90	125	755
12	2,030	1,080	1,960	5,000	3,300	1,710	209	42	42	90	125	680
13	1,830	1,080	1,710	4,570	3,210	1,590	200	42	42	95	125	680
14	1,830	1,220	1,590	4,570	3,070	1,460	192	42	42	95	125	680
15	2,700	1,320	1,480	5,450	2,940	1,370	192	42	42	101	125	680
16	8,290	1,480	1,590	6,160	2,780	1,290	180	42	42	101	125	680
17	14,500	2,390	2,620	5,920	2,460	1,220	168	42	42	110	125	680
18	13,600	1,900	5,400	5,920	2,390	1,170	160	42	42	110	125	680
19	10,300	2,540	5,450	5,920	2,240	1,120	142	42	42	110	125	680
20	11,300	3,770	4,890	5,800	2,240	1,080	142	42	42	110	142	680
21	13,300	2,700	3,860	5,220	2,240	1,040	125	42	42	110	160	680
22	10,700	2,240	5,680	4,890	2,170	970	110	42	42	110	160	680
23	9,470	1,900	5,110	4,680	2,100	870	95	42	42	110	830	680
24	6,790	1,710	4,780	4,460	2,240	808	90	42	42	110	1,810	680
25	5,270	1,480	4,570	4,160	2,390	755	82	42	42	110	2,390	680
26	4,570	1,370	4,360	3,960	2,390	702	70	42	42	110	1,810	680
27	3,770	1,320	3,960	3,960	2,240	680	70	42	42	125	1,540	680
28	3,390	1,270	3,770	3,860	2,240	645	66	42	42	125	1,420	680
29	3,030	.....	4,060	3,860	2,100	596	60	42	42	125	1,270	680
30	2,780	.....	4,780	3,960	2,240	540	60	42	42	125	1,170	680
31	2,240	.....	5,220	.....	2,240	.....	54	42	.....	125	.....	680

NOTE.—These discharges are based on the 1908 rating curve, which is fairly well defined. Discharges from Dec. 12 to 31 reduced 10 per cent on account of ice conditions. January discharges computed as for open-channel conditions. Those for Jan. 1 to 7 may be somewhat too large due to probable ice effect.

Monthly discharge of Owyhee River at Owyhee, Oreg., for 1909.

[Drainage area, 11,100[a] square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	14,500	645	4,770	0.430	0.50	293,000	D.
February	3,770	952	1,660	.150	.16	92,200	B.
March	5,680	1,220	3,150	.284	.33	194,000	A.
April	6,160	3,300	4,840	.436	.49	288,000	A.
May	4,160	2,100	2,910	.262	.30	179,000	A.
June	2,170	540	1,390	.125	.14	82,700	A.
July	456	54	194	.017	.02	11,900	B.
August	54	42	44.2	.0040	.005	2,720	B.
September	762	42	70.9	.0064	.007	4,220	B.
October	125	42	96.0	.0086	.01	5,900	B.
November	2,390	125	503	.045	.05	29,900	B.
December	1,080	680	740	.067	.08	45,500	D.
The year	14,500	42	1,700	.153	2.09	1,230,000	

[a] The drainage area for this station has been revised on the basis of later map measurements.

BOISE RIVER DRAINAGE BASIN.

BOISE RIVER NEAR HIGHLAND, IDAHO.

Boise River rises in the western part of Blaine County and flows westward across Elmore, Ada, and Canyon counties to its junction with Snake River. Its drainage area is mountainous and well wooded.

The gaging station was established July 27, 1905, to replace the station at Boise. It is located 3 miles southwest of Highland post office, about 8 miles above the old Boise station, and 15 miles east of Boise, the nearest railway point.

The records show the total flood waters available from Boise River and are used in connection with the distribution of the low-water flow, all of which is used for irrigation below. (See Pl. VII.)

Moores Creek joins the river 2 miles above the station. The tributaries below are unimportant. But little water is diverted above the station.

Measurements are made from a cable and car at all stages. The gage is on the left bank of the stream about 100 feet below the cable.

The gage heights are somewhat affected by ice during the winter months. The gage datum remained unchanged during 1909.

Discharge measurements of Boise River near Highland, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 28	W. M. O'Neill	241	1,800	10.90	9,980
June 28	.....do	233.5	1,360	9.04	7,480
July 7	.....do	225	1,030	7.35	4,920
18	.....do	208.5	681	5.64	2,610
Nov. 13	O'Neill and Hartwell	186	349	3.70	1,150
21	.....do	214	812	6.20	3,810

Daily gage height, in feet, of Boise River near Highland, Idaho, for 1909.

[Isak Kunzi, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.3	4.6	4.9	8.3	9.6	11.70	9.1	4.6	3.8	3.8	3.8	5.9
2	3.6	4.5	5.0	8.8	9.7	12.85	9.0	4.5	4.0	3.75	4.0	5.7
3	3.75	4.5	5.15	9.2	10.35	13.6	9.0	4.4	4.1	3.65	4.0	5.25
4	3.9	4.45	5.2	8.85	11.15	13.85	8.6	4.3	3.4	3.7	4.0	5.15
5	3.9	4.2	5.35	8.6	12.1	13.90	8.3	4.25	3.85	3.8	3.95	5.1
6	3.8	4.1	5.25	8.2	11.7	13.3	8.15	4.2	4.0	3.8	3.9	5.0
7	3.8	4.2	5.3	7.9	11.3	12.6	8.0	4.15	4.0	3.8	3.9	5.0
8	3.8	4.3	5.4	7.9	11.15	11.8	7.8	4.1	3.9	3.8	3.9	5.0
9	4.0	4.3	5.45	8.0	11.0	11.2	7.6	4.1	3.8	3.75	3.7	5.4
10	3.8	4.2	5.3	8.6	11.0	10.7	6.7	4.1	3.65	3.7	3.8	5.1
11	3.7	4.15	5.25	8.55	10.4	10.0	6.55	4.0	3.7	3.65	4.0	4.75
12	3.65	4.3	5.3	8.5	10.0	9.4	6.5	3.95	3.7	3.65	3.8	4.8
13	3.65	4.7	5.3	8.9	9.9	9.4	6.3	3.9	3.75	3.6	3.7	4.85
14	3.9	4.5	5.5	9.35	9.7	9.4	6.1	3.85	3.6	3.55	3.75	4.7
15	4.2	4.5	5.8	9.6	10.0	11.2	6.0	3.8	3.55	3.55	3.6	4.5
16	5.65	4.9	6.25	9.9	10.2	11.8	5.9	3.75	3.5	3.55	3.5	4.45
17	5.3	5.95	6.5	10.2	10.1	11.7	5.8	3.75	3.5	3.55	3.6	4.3
18	5.7	5.6	6.5	10.2	10.0	11.7	5.6	3.7	3.5	3.55	3.7	4.3
19	6.4	5.3	6.4	10.15	10.2	11.30	5.55	3.7	3.5	3.6	4.2	4.35
20	7.4	5.25	6.5	10.0	10.55	11.1	5.4	3.75	3.5	3.75	6.2	4.1
21	7.6	5.1	6.3	9.85	10.7	10.1	5.25	3.6	3.4	3.7	6.45	4.0
22	7.4	4.8	6.3	9.6	11.0	9.9	5.2	3.55	3.4	3.65	7.25	4.2
23	6.45	4.8	6.45	9.7	11.15	9.4	5.1	3.5	3.5	3.6	12.4	4.35
24	5.8	4.9	6.5	9.8	11.0	9.3	5.0	3.5	3.5	3.6	11.3	4.3
25	5.5	4.9	6.8	9.9	11.0	9.2	4.9	3.55	3.55	3.6	9.5	4.3
26	5.2	4.85	7.0	10.6	11.1	9.0	4.85	3.45	3.5	3.6	8.4	4.4
27	5.0	4.8	7.6	11.15	11.9	8.75	5.0	3.4	3.5	3.55	7.5	4.2
28	4.85	4.85	7.9	11.0	12.45	9.1	5.1	3.35	3.6	3.55	6.8	4.0
29	4.7	.....	8.15	10.4	11.75	9.1	4.85	3.45	3.8	3.6	6.35	3.9
30	4.6	.....	8.0	9.6	11.0	9.1	4.7	3.65	4.0	3.55	6.2	4.0
31	4.6	.....	8.1	.....	11.0	.....	4.5	3.55	.....	3.7	.....	4.2

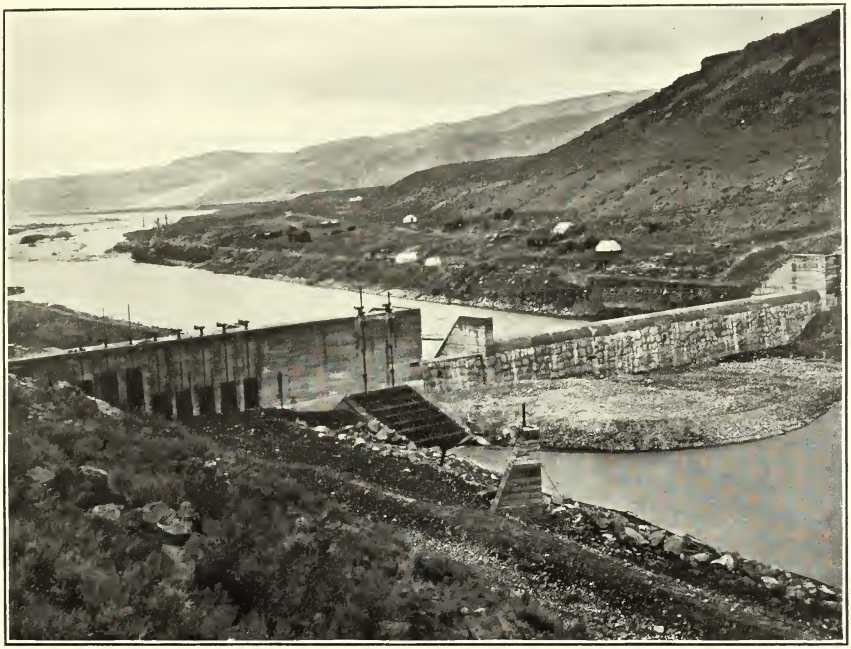
NOTE.—There was slush ice running Jan. 9 to 13, 16, and 23 to 30.

Daily discharge, in second-feet, of Boise River near Highland, Idaho, for 1909.

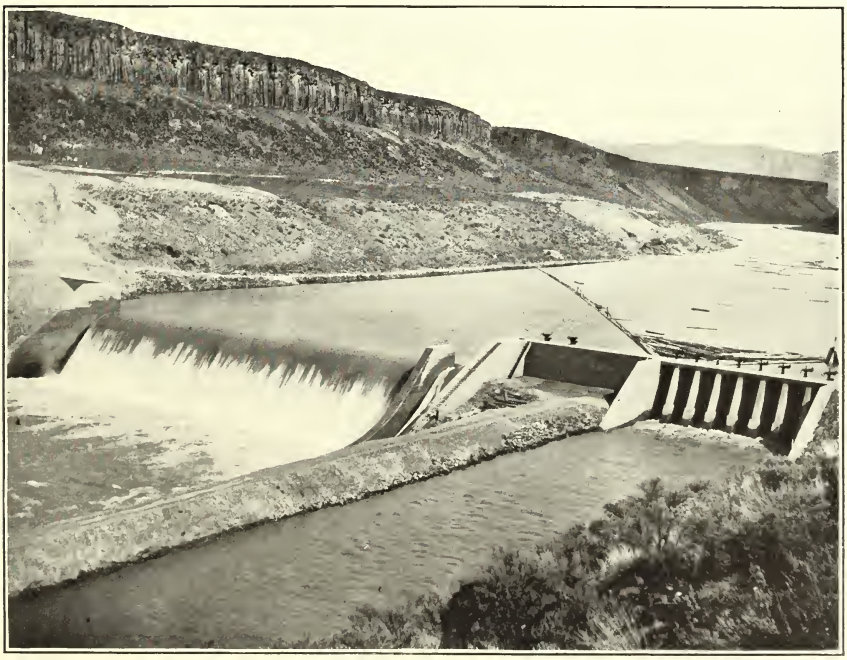
Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	790	1,800	2,160	6,650	7,460	11,600	7,680	1,590	1,020	1,070	1,190	3,460
2	980	1,760	2,270	7,450	7,630	13,900	7,500	1,500	1,170	1,030	1,360	3,200
3	1,100	1,760	2,440	8,200	8,900	15,400	7,500	1,410	1,250	950	1,360	2,660
4	1,220	1,720	2,490	7,550	10,500	15,900	6,780	1,320	750	1,030	1,360	2,540
5	1,220	1,490	2,670	7,100	12,400	16,000	6,260	1,310	1,050	1,120	1,310	2,480
6	1,140	1,400	2,550	6,400	11,600	16,000	6,010	1,270	1,170	1,120	1,270	2,370
7	1,140	1,490	2,610	5,900	10,800	14,600	5,770	1,230	1,170	1,120	1,270	2,370
8	1,140	1,580	2,730	5,900	10,500	13,000	5,470	1,190	1,090	1,120	1,110	2,370
9	1,310	1,580	2,790	5,600	10,200	11,800	5,170	1,190	1,010	1,080	1,150	2,840
10	1,140	1,490	2,610	6,600	10,200	10,800	3,910	1,190	940	1,030	1,230	2,480
11	1,000	1,440	2,550	6,550	9,000	9,400	3,720	1,110	970	1,000	1,390	2,100
12	1,020	1,580	2,610	6,450	8,200	8,230	3,650	1,070	970	1,000	1,230	2,150
13	1,020	1,960	2,610	7,150	8,000	8,230	3,410	1,030	1,000	970	1,150	2,200
14	1,220	1,760	2,850	8,000	7,630	8,230	3,170	1,000	910	930	1,190	2,050
15	1,490	1,760	3,210	8,450	8,200	11,800	3,050	960	870	930	1,070	1,850
16	3,030	2,160	3,780	9,000	8,600	13,000	2,930	930	840	950	990	1,800
17	2,610	3,400	4,130	9,150	8,400	12,800	2,810	950	840	950	1,070	1,660
18	3,090	2,970	4,130	9,150	8,200	12,800	2,590	920	840	950	1,150	1,660
19	3,990	2,610	3,990	9,050	8,600	12,000	2,540	920	840	990	1,570	1,700
20	5,460	2,550	4,130	8,750	9,300	11,600	2,370	950	840	1,100	3,850	1,480
21	5,780	2,380	3,850	8,450	9,600	9,600	2,200	850	780	1,070	4,190	1,390
22	5,460	2,060	3,850	8,000	10,200	9,200	2,150	820	790	1,030	5,400	1,570
23	4,060	2,060	4,060	8,200	10,500	8,230	2,050	790	850	990	15,200	1,700
24	3,210	2,160	4,130	8,350	10,200	8,040	1,970	790	850	990	13,000	1,660
25	2,850	2,160	4,550	8,000	10,200	7,860	1,870	820	880	990	9,450	1,660
26	2,490	2,110	4,840	9,400	10,400	7,500	1,820	760	850	990	7,370	1,750
27	2,270	2,060	5,780	10,500	12,000	7,050	1,970	730	850	950	5,800	1,570
28	2,110	2,110	6,280	10,200	13,100	7,680	2,080	705	920	990	4,700	1,390
29	1,960	.....	6,700	9,000	11,700	7,680	1,820	780	1,070	1,030	4,050	1,310
30	1,860	.....	6,450	7,460	10,200	7,680	1,680	910	1,230	990	3,850	1,390
31	1,860	.....	6,620	.....	10,200	.....	1,500	850	.....	1,110	.....	1,570

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to Mar. 31, fairly well-defined; Apr. 1 to 24, indirect method for shifting channels; Apr. 25 to June 5, fairly well defined; June 6 to July 23, fairly well defined; July 24 to Nov. 8, indirect method for shifting channels; Nov. 9 to Dec. 31, fairly well defined.

The slush ice in January probably did not seriously affect the open-channel conditions.



A. VIEW LOOKING DOWNSTREAM SHORTLY AFTER COMPLETION.



B. VIEW LOOKING UPSTREAM, 4 FEET OF WATER ON SPILLWAY.

RECLAMATION SERVICE DAM ON BOISE RIVER, IDAHO.

Monthly discharge of Boise River near Highland, Idaho, for 1909.

[Drainage area, 2,650 square miles.[a]]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per sq. mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	5,780	790	2,230	0.842	0.97	137,000	B.
February	3,400	1,400	1,980	.747	.78	110,000	B.
March	6,700	2,160	3,760	1.42	1.64	231,000	B.
April	10,500	5,600	7,890	2.98	3.32	469,000	B.
May	13,100	7,460	9,760	3.68	4.24	600,000	B.
June	16,000	7,050	10,900	4.11	4.59	649,000	A.
July	7,680	1,500	3,660	1.38	1.59	225,000	A.
August	1,590	705	1,030	.389	45	63,300	B.
September	1,250	750	954	.360	.40	56,800	B.
October	1.120	930	1,020	.385	.44	62,700	B.
November	15,200	990	3,340	1.26	1.41	199,000	B.
December	3,460	1,310	2,010	.758	.87	124,000	B.
The year	16,000	705	4,040	1.52	20 70	2,930,000	

[a] This drainage area is obtained from a careful measurement on available Government maps and supersedes all previous values.

CANAL SEEPAGE IN BOISE VALLEY, IDAHO.

During July, 1909, an investigation was conducted jointly by the United States Reclamation Service, United States Geological Survey, and the State of Idaho to determine the amount of loss by seepage and evaporation in the canals in Boise Valley. This task was rendered exceedingly difficult by the short time available, which necessitated the use of the so-called instantaneous method of measurement, and also by the fact that the managers of the canal systems were unwilling to have the flow of water regulated for any considerable length of time in the main canals for fear of complaints from water users. Some fear was also felt that the experiments might injure their rights to use of water.

Measurements were made on the Farmers Union canal July 9 and 13, on the Settlers canal July 15, on the Eureka canal July 19, on the Caldwell High Line canal July 21, and on the Middleton Water Co. canal July 24.

Gages graduated to be read to 0.01 foot were so located at the measuring sections that they immediately indicated any change in the water level of the canal, but were not subject to wave action. These gages were read every few minutes during measurements.

The vertical velocity curve method was employed in making the measurements, the measuring points being at 0.25-foot intervals from the surface, and the bottom point being as near the bed of the canal as the meter could be held. The bottom point of two of the meters used was 0.45 foot; the third meter was used with the weight above the cups and could be lowered to 0.15 foot of the bottom. The slight difference in the ratings of the meter was negligible.

The canal sections were selected with reference to (1) the character of canal between stations, whether bottom, side-hill, or bench canals; (2) the regularity of flow; (3) the character of bottom and cross-section of the canal at station; (4) the length of section to be measured; and (5) the number of laterals to be measured or turned off.

The method of procedure in making a test on a canal was as follows: Measurements were begun at the upper station of the canal by a party consisting of two engineers, and were carried on quickly until all the other sections had been measured. All water diverted from the main canal between measuring sections by laterals was also measured and accounted for. In making the measurements on the Farmers Union canal on July 13 three parties were employed throughout the day, each party measuring at each of the three sections in turn. The headgates at the river were regulated and the water surface in the canal held all day at as nearly a constant level as possible.

The summary of the results obtained in this seepage investigation is given in the following table:

Summary of seepage investigation on canals in Boise Valley in July, 1909.

Canals.	Date.	Character of canal.	Length.	Discharge.	Gain (+) or loss (−) in section.	Gain (+) or loss (−) per mile.	Gain (+) or loss (−) in per cent per mile.	Gain (+) or loss (−) in second-feet per day per square foot of wetted canal surface.	Remarks.
			Miles.	*Sec.-ft*	*Sec.-ft.*	*Sec.-ft*			
Farmers Union canal:									
First test, section A–B....	July 9	Bottom...	1.85	111.11	+1.48	+0.8	+0.72	+0.52	Clay.
Second test, section A–B..	July 13	....do.....	1.85	96.63	+2.11	+1.14	+1.18	+ .75	Do.
Second test, section B–C..	...do....	Side hill ..	3.31	97.99	+ .89	+ .27	+ .27	+ .20	Sand and gravel.
Eureka canal: Section A–B...	July 19	Bottom...	2.26	24.54	+4.64	+2.05	+8.36	+2.52	Clay.
Settlers canal:[a]									
Section A–B.....	July 15	Side hill...	1.43	156.53	−2.64	−1.84	−1.18	−1.07	Sand and gravel.
Section B–D.....	...do....	Sidehilland bench.	2.68	154.14	−1.72	− .62	− .42	− .44	Do.
Caldwell High Line canal:									
Section A–B.....	July 21	....do.....	2.25	115.95	−2.64	−1.17	−1.01	− .67	Do.
Section B–C.....	...do....	....do.....	1.02	113.37	− .70	− .69	− .61	− .43	Clay.
Middleton Light & Water Co. canal: Section A–B.....	July 24	Bottom...	1.73	101.34	[b]−2.20	−1.27	−1.25	− .83	Do.

[a] Results at station C discarded as not being reliable.
[b] This loss is balanced by waste water entering the canal from higher lands.

From the foregoing observations it would appear that in the bottom canals, when the land on either side of the canal is irrigated, there is practically no loss from seepage and evaporation, but that in nearly all there is a gain and that in some of the canals the gain is very marked. The side hill and bench canals lose slightly, averaging about 1 per cent per mile for canals carrying from 100 to 200 second-feet. In nearly all canals or sections of canals on the river

bottoms the seepage and waste water from irrigated lands above a canal tends to compensate for losses by seepage and evaporation. The bench-land canals have a much greater apparent loss than canals in the lower or bottom lands.

MALHEUR RIVER DRAINAGE BASIN.

DESCRIPTION.

Malheur River rises in the eastern part of Harney County, flows northward, receiving the Middle Fork near Riverside, the North Fork near Juntura, and Bully Creek at Vale, and discharges into Snake River at Ontario. Its drainage area, which includes the southeastern slope of the Blue Mountains and the eastern border of the divide that marks the boundary of the Great Basin in Oregon, is fan shaped, the outer border extending 140 miles along the mountain summits. The basin at the mouth of the river measures 4,150 square miles and at Riverside 1,910 square miles.

Elevations within the basin range from 5,000 feet at the headwaters to 2,000 at the mouth. The country is generally rough and broken and is largely covered with sagebrush. Irrigation is restricted to the lower lands immediately adjoining the streams. The headwater areas are lightly forested, but elsewhere the area is timberless and is utilized as range for cattle and sheep.

The mean annual rainfall ranges from 16 inches on the headwaters to 10 inches at Vale. During the winter months the streams are icebound for part of the time.

This area offers some exceptional advantages for irrigation, for in it are combined large storage possibilities, ample stream flow, and enormous areas of desert lands.

MALHEUR RIVER AT VALE, OREG.

This station was originally established March 20, 1890. Observations were suspended June 30, 1891, resumed January 1, 1895, suspended again September 30, 1896, and again resumed May 20, 1903. They were interrupted from April 1, 1907, to May 29, 1908. The station at present is located within the city limits of Vale, one-fourth mile below the mouth of Bully Creek and 2½ miles above the mouth of Willow Creek. The datum of the chain gage has not been changed since May 20, 1903.

The data obtained at this station are very valuable, as the waters of the stream are extensively used for irrigation, the low-water flow being entirely appropriated for this purpose. Measurements do not show the natural flow of the stream because of diversions for irrigation above.[1]

[1] For a summary of canal diversions in Malheur River drainage, see Water-Supply Paper 252, p. 257.

The following discharge measurement was made by F. F. Henshaw:

October 20, 1909: Width, 77 feet; area, 63 square feet; gage height, 3.70 feet; discharge, 97 second-feet. Made by wading 600 feet above regular section.

Daily gage heights, in feet, of Malheur River at Vale, Oreg., for 1909.

[Z. G. Wilson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.91	4.70	4.85	5.55	4.88	4.52	3.80	3.23	3.17	3.65	3.80	4.32
2	3.93	4.70	5.40	5.60	4.86	4.52	3.59	3.23	3.17	3.65	3.80	4.48
3	3.68	4.72	5.55	5.65	4.74	4.54	3.56	3.22	4.92	3.69	3.81	4.48
4	3.65	4.70	5.60	5.85	4.69	4.54	3.52	3.23	4.71	3.67	3.80	4.49
5	3.59	4.71	5.62	5.70	4.62	4.68	3.50	3.21	4.58	3.67	3.82	4.37
6	3.55	4.70	5.58	5.60	4.58	4.75	3.48	3.21	4.27	3.65	3.82	4.30
7	3.55	4.80	5.35	5.47	4.58	4.70	3.48	3.20	4.20	3.62	3.84	4.30
8	6.04	4.68	5.12	5.30	4.56	4.65	3.47	3.20	3.77	3.59	3.84	4.19
9	6.25	4.55	4.95	5.16	4.60	4.60	3.44	3.18	3.62	3.55	3.86	3.98
10	6.25	4.45	4.90	5.17	4.54	4.56	3.40	3.17	3.57	3.52	3.86	3.87
11	6.15	4.78	4.85	5.35	4.53	4.50	3.55	3.17	3.52	3.54	3.87	3.80
12	4.80	4.90	4.70	5.35	4.53	4.50	3.50	3.19	3.47	3.60	3.90	3.59
13	4.80	4.91	4.66	5.38	4.46	4.45	3.50	3.17	3.47	3.64	3.92	3.59
14	4.78	5.80	4.77	5.45	4.42	4.42	3.48	3.20	3.62	3.67	3.90	3.56
15	4.78	5.81	5.00	5.45	4.37	4.30	3.47	3.17	3.59	3.67	3.90	3.55
16	10.98	5.56	5.35	5.54	4.34	4.24	3.47	3.19	3.57	3.67	3.92	3.56
17	10.00	7.75	5.80	5.54	4.28	4.18	3.46	3.20	3.58	3.67	3.88	3.55
18	8.80	7.06	5.60	5.58	4.22	4.15	3.45	3.20	3.57	3.67	3.88	3.52
19	8.80	6.45	5.35	5.52	4.12	4.15	3.45	3.17	3.57	3.67	3.84	3.52
20	8.85	6.07	5.55	5.48	4.14	4.39	3.45	3.17	3.57	3.65	3.84	3.60
21	8.40	5.48	5.33	5.42	4.15	4.26	3.45	3.17	3.55	3.70	3.98	3.72
22	8.20	5.20	5.25	5.28	4.14	4.19	3.44	3.16	3.57	3.70	3.98	3.90
23	7.16	5.12	5.05	5.18	4.17	4.18	3.43	3.15	3.59	3.69	4.02	3.90
24	6.85	5.02	5.05	5.16	4.20	4.15	3.38	3.15	3.57	3.70	4.40	4.00
25	5.52	4.90	5.12	5.16	4.18	4.08	3.37	3.13	3.57	3.70	4.60	4.00
26	5.20	4.90	5.22	4.92	4.22	4.02	3.37	3.16	3.57	3.72	4.62	4.10
27	5.07	4.88	5.35	4.90	4.24	3.91	3.34	3.15	3.59	3.72	4.43	4.10
28	5.04	4.85	5.53	4.90	4.28	3.86	3.33	3.16	3.60	3.74	4.28	4.10
29	4.84	.....	5.70	4.90	4.39	3.82	3.33	3.15	3.62	3.75	4.22	4.10
30	4.45	.....	5.82	4.93	4.39	3.84	3.31	3.15	3.62	3.75	4.27	4.10
31	4.72	.....	5.58	.....	4.42	.....	3.32	3.15	.....	3.78	.....	4.10

NOTE.—Ice conditions Jan. 12 to 15 and from about Dec. 22 to 31. Ice reported 1 to 10 inches thick Dec. 25.

Daily discharge, in second-feet, of Malheur River at Vale, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	119	520	610	1,130	628	412	118	34	29	88	118	310
2	123	520	1,010	1,170	580	412	78	34	29	88	118	390
3	82	532	1,130	1,210	544	424	73	33	654	95	120	390
4	78	520	1,170	1,380	514	424	67	34	526	92	118	395
5	71	526	1,190	1,250	472	508	64	32	448	92	123	335
6	68	520	1,150	1,170	448	550	61	32	285	88	123	300
7	68	580	970	1,070	448	520	61	31	250	83	128	300
8	1,220	508	794	930	436	490	60	31	112	78	128	246
9	1,400	430	675	822	460	460	56	30	83	72	132	164
10	1,400	375	640	829	424	436	51	29	74	67	132	135
11	1,320	568	610	970	418	400	72	29	67	70	135	118
12	420	640	520	970	418	400	64	30	60	79	142	78
13	420	647	496	994	380	375	64	29	60	86	148	78
14	410	1,330	562	1,050	360	360	61	31	83	92	142	73
15	410	1,340	710	1,050	335	300	60	29	78	92	142	72
16	7,970	1,140	970	1,120	320	270	60	30	74	92	148	73
17	6,500	3,460	1,330	1,120	290	241	59	31	76	92	137	72
18	4,820	2,620	1,170	1,150	260	228	58	31	74	92	137	67
19	4,820	1,950	970	1,110	214	228	58	29	74	92	128	67
20	4,880	1,570	1,130	1,070	223	345	58	29	74	88	128	79

Daily discharge, in second-feet, of Malheur River at Vale, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	4,300	1,070	954	1,030	228	280	58	29	72	97	164	70
22	4,040	850	890	914	223	246	56	28	74	97	164	70
23	2,740	794	745	836	236	241	55	28	78	95	177	70
24	2,380	724	745	822	250	228	49	28	74	97	350	70
25	1,110	640	794	822	241	198	48	26	74	97	460	70
26	850	640	866	654	260	177	48	28	74	101	472	70
27	759	628	970	640	270	145	44	28	78	101	365	70
28	738	610	1,110	640	290	132	43	28	79	105	290	70
29	604	.....	1,250	640	345	123	43	28	83	108	260	70
30	375	.....	1,350	661	345	128	41	28	83	108	285	70
31	532	.....	1,150	.....	360	.....	42	28	.....	114	.....	70

NOTE.—These discharges are based on rating curves that are applicable as follows: Jan. 1 to 15, fairly well defined; Jan. 16 to Dec. 20, not well defined; discharges Dec. 21 to 31 estimated because of ice conditions.

Monthly discharge of Malheur River at Vale, Oreg., for 1909.

[Drainage area, 4,190 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	7,970	68	1,780	0.425	0.49	109,000	B.
February	3,460	375	938	.224	.23	52,100	B.
March	1,350	496	924	.221	.25	56,800	B.
April	1,380	640	974	.232	.26	58,000	B.
May	628	214	362	.086	.10	22,300	B.
June	550	123	323	.077	.09	19,200	B.
July	118	41	59.0	.014	.02	3,630	C.
August	34	26	29.8	.0071	.008	1,830	C.
September	654	29	133	.032	.04	7,910	B.
October	114	67	91.5	.022	.03	5,630	B.
November	472	118	187	.045	.05	11,100	B.
December	395	67	146	.035	.04	8,980	C.
The year	7,970	26	496	.118	1.61	356,000	

MIDDLE FORK OF MALHEUR RIVER ABOVE SOUTH FORK, AT RIVERSIDE, OREG.

This station, which is located about 200 feet above the mouth of South Fork of Malheur River at Riverside, Oreg., was established January 3, 1906, to determine the amount of water available for storage in the Warm Springs reservoir site about 6 miles above. At present a large part of the summer flow is used for irrigation in small ditches that water the lands immediately contiguous to the stream.

A temporary vertical staff gage, located about 400 feet above the cable, was used until January 24, 1906, when it was replaced by a permanent sloping staff gage 15 feet below the cable. This was used until washed out on March 29, 1906. It was replaced, May 8, 1906, by a chain gage at the same location and datum. The gage readings during the interval were read from a temporary gage and reduced to the chain-gage datum. The station was discontinued March 31, 1907, on account of its inaccessibility and excessive cost. It was,

however, reestablished December 15, 1908, and a new vertical staff gage installed about 200 feet above the cable on the left bank. An auxiliary chain gage was also installed at the cable in order to determine a relation between the gages at the two locations, but as the chain gage was destroyed on January 15, 1909, this relation was not determined. It is believed, however, that the form of the curve for both locations is practically the same. As the gage heights from the chain gage were affected by backwater from the South Fork this gage was not replaced.

The conditions at the staff gage above the cable are not favorable for refined results. The bed of the stream is of gravel and liable to change during freshets.

Ice interferes somewhat with winter records. Ice jams frequently form and cause backwater.

Gage heights for this station for 1906, 1907, and 1908 appeared in Water-Supply Papers 214, page 103, and 252, page 260.

Discharge measurements of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., in 1906 and 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1906.					
May 9	R. S. Hall	86	156	[a] 2.18	495
1909.					
Feb. 9	R. B. Post	66	58	2.57	127
Mar. 22	do	89	96	3.02	268
June 27	do	90	52	2.35	63
Nov. 21	do	86	59	2.30	68

[a] At old gage datum.

Daily gage height, in feet, of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., for 1909.

[J. C. Blaylock, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1			2.85	3.6	3.3	2.9	3.8	1.7	1.5	2.8	2.7	2.4
2			3.1	3.7	3.2	2.9	3.8	1.7	1.5	2.8	2.6	2.3
3	3.45		3.2	3.9	3.2	2.8	3.1	1.7	1.5	2.7	2.6	2.3
4	3.15		3.2	3.9	3.2	3.0	3.1	1.8	1.6	2.7	2.5	2.3
5	3.05		3.5	3.5	3.1	3.1	3.1	1.6	1.6	2.7	2.4	2.3
6	3.00		3.2	3.5	3.3	3.0	2.1	1.4	1.6	2.7	2.4	2.3
7	3.25		3.0	3.4	3.3	2.9	2.1	1.4	1.6	2.7	2.4	2.3
8	3.4	2.48	2.9	3.3	3.1	2.9	2.1	1.4	1.7	2.7	2.5	2.3
9	4.35	2.51	2.9	3.4	3.1	2.9	2.1	1.4	1.7	2.7	2.5	2.3
10	3.2	2.4	2.8	3.5	3.1	2.8	2.1	1.4	2.6	2.7	2.5	2.2
11		2.4	2.6	3.6	3.1	2.8	2.1	1.4	2.6	2.6	2.6	2.2
12		2.45	2.6	3.6	3.1	2.7	2.1	1.4	2.6	2.6	2.6	2.4
13		2.7	2.6	3.5	3.1	2.6	2.1	1.4	2.6	2.5	2.6	2.4
14		4.05	2.9	3.8	3.0	2.6	2.1	1.4	2.4	2.5	2.6	2.4
15		3.2	3.2	3.9	2.5	2.6	2.1	1.4	2.4	2.5	2.6	2.4
16		3.1	3.4	4.0	2.5	2.5	2.0	1.4	2.4	2.6	2.5	2.3
17	5.88	4.9	3.5	4.1	2.6	2.5	2.0	1.4	2.5	2.5	2.4	2.2
18	4.9	4.5	3.7	4.1	2.6	2.5	2.0	1.4	2.5	2.5	2.3	2.2
19	4.7	3.5	3.4	3.9	2.6	2.5	2.0	1.4	2.6	2.5	2.3	2.2
20	5.7	3.4	3.2	3.8	2.5	2.5	1.9	1.4	2.6	2.5	2.3	2.2

Daily gage height, in feet, of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., in 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	5.35	2.9	3.1	3.8	2.4	2.5	1.9	1.4	2.6	2.6	2.3	2.2
22	4.7	2.85	3.05	3.6	2.4	2.5	1.9	1.4	2.6	2.6	2.4	2.2
23	3.45	2.65	3.05	3.5	2.5	2.5	1.9	1.4	2.6	2.6	2.6	2.2
24	3.1	2.7	3.1	3.5	2.5	2.5	1.9	1.4	2.6	2.7	3.1*	2.3
25	.....	2.8	3.3	3.4	2.6	2.5	1.8	1.4	2.7	2.7	3.0	2.3
26	.....	2.75	3.2	3.3	2.6	2.35	1.8	1.4	2.7	2.7	2.8	2.3
27	.....	2.7	3.5	3.3	2.6	2.35	1.8	1.4	2.7	2.7	2.5	2.4
28	.....	2.8	3.6	3.4	2.6	2.35	1.8	1.4	2.7	2.7	2.5	2.2
29	.....	.....	3.9	3.5	2.9	2.35	1.8	1.4	2.7	2.7	2.4	2.2
30	.....	.....	3.8	3.3	2.9	2.35	1.8	1.4	2.8	2.8	2.4	2.2
31	.....	.....	3.5	.....	2.9	.....	1.7	1.5	.....	2.7	.....	2.2

NOTE.—Ice conditions Jan. 1 to 3 and Dec. 11 to 31.

Daily discharge, in second-feet, of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., for 1906–7 and 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1906.									
1	120	3,480	505	505	200	16	16	62	62
2	120	3,400	505	460	200	16	16	62	110
3	120	3,300	505	460	200	16	16	62	110
4	120	3,200	505	505	170	8	16	62	110
5	120	3,200	505	550	140	8	16	62	110
6	200	3,200	505	505	140	8	16	62	110
7	300	3,200	505	505	110	8	16	62	110
8	500	3,200	460	460	110	8	16	62	110
9	460	3,200	505	460	110	8	16	62	110
10	420	3,200	505	460	110	8	16	84	110
11	380	3,200	505	460	84	8	16	84	110
12	340	2,900	460	420	84	8	16	84	110
13	305	2,600	505	420	84	8	16	140	110
14	270	2,400	460	380	84	8	28	140	10
15	250	2,200	460	380	62	8	43	62	110
16	250	1,900	460	380	62	12	28	62	110
17	250	1,700	420	340	84	8	28	84	140
18	250	1,500	420	340	84	8	28	84	140
19	250	1,300	380	305	62	8	28	84	140
20	250	1,090	340	305	62	8	28	84	140
21	300	1,220	340	270	62	8	28	84	110
22	340	1,160	305	270	62	8	43	84	110
23	460	1,160	305	270	62	8	43	84	200
24	1,380	910	305	235	62	8	43	84	235
25	1,630	855	305	200	43	8	43	84	200
26	1,420	855	270	200	43	8	43	84	200
27	1,660	745	340	270	43	8	43	84	170
28	1,700	695	460	235	43	8	62	84	140
29	1,700	595	645	200	28	16	62	84	140
30	2,200	505	800	235	28	16	62	84	140
31	2,870	.....	645	.....	28	16	.....	62	.....

NOTE.—Daily discharges for 1906–7 are based on a rating curve defined by one measurement made in 1906, and the general form of the 1909 curve. Discharges for January, 1907, estimated because of ice conditions.

Daily discharge, in second-feet, of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., for 1906–7 and 1909.

Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.	Day.	Jan.	Feb.	Mar.
1907.				1907.				1907.			
1	80	940	595	11	70	645	420	21	110	505	1,420
2	80	460	550	12	70	645	420	22	110	505	1,190
3	80	1,220	460	13	130	550	420	23	84	505	1,060
4	80	3,800	460	14	130	550	400	24	84	505	882
5	80	4,500	420	15	170	505	800	25	140	505	695
6	80	2,750	420	16	170	505	855	26	110	882	800
7	110	1,420	550	17	170	505	970	27	110	645	645
8	90	882	505	18	170	505	1,320	28	420	645	550
9	90	645	505	19	140	460	2,680	29	160	.....	595
10	90	695	460	20	110	460	2,050	30	500	.....	550
								31	500	.....	595

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	100	196	215	510	380	230	610	8	3	200	170	85
2	200	183	300	560	340	230	610	8	3	200	140	63
3	442	170	340	665	340	200	300	8	3	170	140	63
4	320	157	340	665	340	265	300	12	5	170	110	63
5	282	144	465	465	300	300	300	5	5	170	85	63
6	265	131	340	465	380	265	32	2	5	170	85	63
7	360	118	265	420	380	230	32	2	5	170	85	63
8	420	105	230	380	300	230	32	2	8	170	110	63
9	930	113	230	420	300	230	32	2	8	170	110	63
10	340	85	200	465	300	200	32	2	140	170	110	45
11	320	85	140	510	300	200	32	2	140	140	140	40
12	300	98	140	510	300	170	32	2	140	140	140	76
13	300	170	140	465	300	140	32	2	140	110	140	76
14	300	750	230	610	265	140	32	2	85	110	140	76
15	300	340	340	665	110	140	32	2	85	110	140	76
16	1,800	300	420	720	110	110	22	2	85	140	110	57
17	1,950	1,280	465	780	140	110	22	2	110	110	85	40
18	1,280	1,020	560	780	140	110	22	2	110	110	63	40
19	1,140	465	420	665	140	110	22	2	140	110	63	40
20	1,820	420	340	610	110	110	16	2	140	110	63	40
21	1,580	230	300	610	85	110	16	2	140	140	63	40
22	1,140	215	282	510	85	110	16	2	140	140	85	40
23	442	155	282	465	110	110	16	2	140	140	140	40
24	300	170	300	465	110	110	16	2	140	170	300	57
25	287	200	380	420	140	110	12	2	170	170	265	57
26	274	185	340	380	140	74	12	2	170	170	200	57
27	261	170	465	380	140	74	12	2	170	170	110	76
28	248	200	510	420	140	74	12	2	170	170	110	40
29	235	.....	665	465	230	74	12	2	170	170	85	40
30	222	.....	610	380	230	74	12	2	200	200	85	40
31	209	.....	465	.....	230	.....	8	3	.....	170	.....	40

NOTE.—Daily discharges for 1906–7 are based on a rating curve defined by one measurement made in 1906, and the general form of the 1909 curve. Discharges for January, 1907, estimated because of ice conditions.

The daily discharges for 1909 are based on a rating curve well defined between 60 and 800 second-feet. Discharges interpolated for days when gage heights were missing. Discharges from Dec. 11 to 31 reduced 10 per cent on account of ice conditions.

Monthly discharge of Middle Fork of Malheur River above South Fork, at Riverside, Oreg., for 1906–7 and 1909.

Drainage area, 1,110 square miles.

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1906.							
March	2,870	120	677	0.610	0.70	41,600	.....
April	3,480	505	2,070	1.86	2.08	123,000	.....
May	800	270	456	.411	.47	28,000	.....
June	550	200	366	.330	.37	21,800	.....
July	200	28	88.6	.080	.09	5,450	.....
August	16	8	9.68	.0087	.01	595	.....
September	62	16	29.7	.027	.03	1,770	.....
October	140	62	79.1	.071	.08	4,860	.....
November	235	62	131	.118	.13	7,800	.....
December	.....	.....	[a] 130	.117	.13	7,990	.....
The period	.....	.....	.....	.....	.....	243,000	.....
1907.							
January	.....	.....	[a] 146	.132	.15	8,980	.....
February	4,500	460	976	.879	.92	54,200	.....
March	2,680	400	782	.705	.81	48,100	.....
1909.							
January	1,950	100	592	.533	.61	36,400	C.
February	1,280	85	280	.252	.26	15,600	B.
March	665	140	346	.312	.36	21,300	A.
April	780	380	528	.476	.53	31,400	A.
May	380	85	223	.201	.23	13,700	A.
June	300	74	155	.140	.16	9,220	A.
July	610	8	86.7	.078	.090	5,330	C.
August	12	2	3.03	.0027	.003	186	D.
September	200	3	99.0	.089	.10	5,890	C.
October	200	110	154	.139	.16	9,470	B.
November	300	63	122	.110	.12	7,260	B.
December	85	40	55.5	.050	.06	3,410	D.
The year	1,950	2	220	.199	2.68	159,000	

[a] Estimated because of ice conditions.

NOTE.—The monthly estimates for 1906 and 1907 are only approximate, hence no accuracy values are given.

MIDDLE FORK OF MALHEUR RIVER BELOW SOUTH FORK, AT RIVERSIDE, OREG.

This station, which is located at the county highway bridge about 1,000 feet below the mouth of the South Fork of Malheur River at Riverside, Oreg., was established December 15, 1908, to determine the amount of water flowing through the canyon of Malheur River. Gage height observations were not begun until January 16, 1909, as it was at first not intended to maintain the station regularly.

The vertical staff gage is attached to the right abutment of the bridge from which discharge measurements are made.

Ice interferes somewhat with winter records as at the station above the mouth of the South Fork.

As the gage heights are rather uncertain they are withheld until more data are obtained. No rating curve has yet been developed.

Discharge measurements of Middle Fork of Malheur River below South Fork, at Riverside, Oreg., in 1909.

Date.	Hydrographer.	Width	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Feb. 9	R. B. Post	108	243	1.97	168
Mar. 22	....do	112	277	2.50	300
Nov. 21	....do	.....	.....	1.47	[a] 88

[a] Discharge found by adding flow of South Fork to that of Middle Fork above South Fork.

NORTH FORK OF MALHEUR RIVER NEAR BEULAH, OREG.

This station, which is located 7 miles below Beulah, Oreg., in sec. 33, T. 20 S., R. 37 E., was established March 21, 1909. The gage is of the chain-and-weight type.

The records represent practically the total run-off of North Fork and are of especial value as showing the quantity for storage in the Beulah or Agency Valley reservoir site just above.

Measurements are made from a standard cable equipment. The right bank is low but is not liable to overflow. The left bank is high and rocky. The bed of the stream is composed of gravel and will change in ordinary freshets.

Discharge measurements of North Fork of Malheur River near Beulah, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft*
June 28	R. B. Post	36	42	2.30	98
Nov. 19	....do	33	30	1.96	49

Daily gage height, in feet, of North Fork of Malheur River near Beulah, Oreg., for 1909.

[F. E. Holliday, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.95	2.8	2.76	2.15	1.9	1.9	2.0	2.1	2.2
2	.....	3.0	2.75	2.8	2.1	1.9	1.9	2.0	2.1	2.15
3	.....	3.0	2.75	2.9	2.1	1.9	1.9	2.0	2.1	1.95
4	.....	2.95	2.85	3.0	2.05	1.85	2.35	2.0	2.1	1.9
5	.....	2.9	2.85	3.0	2.05	1.85	2.0	2.0	2.08	2.0
6	.....	2.85	2.85	3.0	2.05	1.85	2.15	2.0	2.08	2.1
7	.....	2.85	2.88	2.95	2.05	1.85	2.1	2.0	2.08	2.15
8	.....	2.85	2.85	2.9	2.05	1.8	2.1	2.0	2.08	2.2
9	.....	2.8	2.8	2.8	2.05	1.8	2.05	2.0	2.08	2.2
10	.....	2.8	2.8	2.75	2.05	1.82	2.05	2.0	2.08	2.1
11	.....	2.85	2.8	2.75	2.0	1.8	2.05	2.0	2.1	2.1
12	.....	2.8	2.78	2.65	2.0	1.75	2.0	2.0	2.1	2.1
13	.....	2.8	2.7	2.6	2.0	1.75	2.0	2.0	2.1	2.1
14	.....	2.95	2.7	2.6	2.0	1.8	2.0	2.0	1.95	2.1
15	.....	2.95	2.7	2.6	2.0	1.8	1.98	2.0	1.95	2.1
16	.....	3.0	2.65	2.6	2.0	1.85	1.98	2.0	2.0	2.05
17	.....	3.0	2.65	2.6	1.95	1.88	1.98	2.0	1.95	2.0
18	.....	3.0	2.65	2.6	1.9	1.9	1.95	2.0	2.15	2.0
19	.....	2.95	2.65	2.6	1.9	1.9	1.95	2.0	2.15	2.0
20	.....	2.9	2.6	2.65	1.9	1.85	1.95	2.0	2.15	1.95

Daily gage height, in feet, of North Fork of Malheur River near Beulah, Oreg., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2.6	2.85	2.6	2.6	1.8	1.9	1.96	2.0	2.2	1.95
22	2.55	2.85	2.6	2.55	1.8	1.9	1.95	2.0	2.3	1.95
23	2.6	2.83	2.6	2.55	1.8	1.9	1.95	2.0	2.9	1.95
24	2.8	2.85	2.6	2.55	1.8	1.9	2.0	2.0	2.75	1.9
25	2.85	2.7	2.6	2.45	1.85	1.9	2.0	2.0	2.5	1.9
26	2.95	2.7	2.6	2.35	1.85	1.9	2.0	2.0	2.2	2.0
27	3.0	2.8	2.7	2.3	1.85	1.9	2.05	2.0	2.3	2.0
28	3.1	2.85	2.75	2.3	1.85	1.9	2.05	2.0	2.3	2.05
29	3.3	2.85	2.85	2.3	1.85	1.9	2.05	2.0	2.3	2.1
30	3.0	2.8	2.8	2.25	1.95	1.9	2.05	2.2	2.2	2.15
31	2.9	.....	2.75	.....	1.95	1.9	.....	2.3	.....	2.2

NOTE.—No ice reported. Probably ice during part of December.

Daily discharge, in second-feet, of North Fork of Malheur River near Beulah, Oreg., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	242	199	189	74	41	41	53	67	82
2	.....	257	187	199	67	41	41	53	67	74
3	.....	257	187	227	67	41	41	53	67	47
4	.....	242	213	257	60	36	106	53	67	41
5	.....	227	213	257	60	36	53	53	64	53
6	.....	213	221	257	60	36	74	53	64	67
7	.....	213	221	242	60	36	67	53	64	74
8	.....	213	213	227	60	30	67	53	64	82
9	.....	199	199	199	60	30	60	53	64	82
10	.....	199	199	187	60	32	60	53	64	67
11	.....	213	199	187	53	30	60	53	67	67
12	.....	199	194	164	53	25	53	53	67	67
13	.....	199	175	153	53	25	53	53	67	67
14	.....	242	175	153	53	30	53	53	47	67
15	.....	242	175	153	53	30	51	53	47	67
16	.....	257	164	153	53	36	51	53	53	60
17	.....	257	164	153	47	39	51	53	47	53
18	.....	257	164	153	41	41	47	53	74	53
19	.....	242	164	153	41	41	47	53	74	53
20	.....	227	153	164	41	36	47	53	74	47
21	153	213	153	153	30	41	48	53	82	47
22	143	213	153	143	30	41	47	53	98	47
23	153	207	153	143	30	41	47	53	227	47
24	199	213	153	143	30	41	53	53	187	41
25	213	175	153	124	36	41	53	53	133	41
26	242	175	153	106	36	41	53	53	82	53
27	257	199	175	98	36	41	60	53	98	53
28	289	213	187	98	36	41	60	53	98	60
29	355	213	213	98	36	41	60	53	98	67
30	257	199	199	90	47	41	60	82	82	74
31	227	.....	187	.....	47	41	.....	98	.....	82

NOTE.—These discharges are based on a rating curve that is well defined between 40 and 180 second-feet.

Monthly discharge of North Fork of Malheur River near Beulah, Oreg., for 1909.

[Drainage area, 436 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 21-31	355	143	226	0.518	0.21	4,940	A
April	257	175	221	.507	.57	13,200	A
May	221	153	183	.420	.48	11,300	A
June	257	74	167	.383	.43	9,940	A
July	74	30	48.7	.112	.13	2,990	B
August	41	25	36.9	.085	.10	2,270	B
September	106	41	55.5	.127	.14	3,300	B
October	98	53	55.4	.127	.15	3,410	B
November	227	47	81.8	.188	.21	4,870	B
December	82	41	60.7	.139	.16	3,730	B
The period	355	25	.....	.....	.....	60,000	

PAYETTE RIVER DRAINAGE BASIN.

DESCRIPTION.

Payette River rises in the eastern part of Boise County, Idaho, and flows in a generally westerly direction to its junction with Snake River near Payette, Idaho. It is about 110 miles long and drains an area comprising approximately 3,565 square miles. Its basin is well wooded and mountainous and is similar to that of Boise River.

The principal tributaries of the Payette are its Middle and North forks. The low-water flow of the river is appropriated for irrigation in the valleys below Horseshoe Bend, but more than a million acre-feet of flood water runs to waste each year. Payette Lake, at the head of the North Fork, affords a good storage site, which will be used by the United States Reclamation Service.

PAYETTE RIVER NEAR HORSESHOE BEND, IDAHO.

This station, which was established February 13, 1906, to determine the total amount of water available for irrigation, is located on the main river, about 10 miles below the junction of the North and South Forks, at a point known as Jerusalem, 5 miles above Horseshoe Bend post office, and about 32 miles from Boise, the most convenient railway point.

There are no tributaries below the station except small creeks, which are dry the greater part of the year. Squaw Creek is the largest of these. As no water is diverted above the station, the records give the total amount of water available from the upper Payette basin.

The gage heights are not affected by ice, but some irregularities in daily flow are caused by flushing during the logging season. The gage datum has remained unchanged.

Discharge measurements of Payette River near Horseshoe Bend, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 23	Wm. M. O'Neill	277	1,290	7.15	6,440
June 26	do	295	1,900	9.04	11,600
Nov. 12	O'Neill and Hartwell	252	563	4.53	1,490

Daily gage height, in feet, of Payette River near Horseshoe Bend, Idaho, for 1909.

[E. R. Sherard, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.15	4.75	4.7	5.8	7.5	10.7	8.65	5.3	4.65	4.85	4.5	5.85
2	4.2	4.75	4.7	5.95	7.6	10.7	8.6	5.3	4.8	4.85	4.5	5.6
3	4.2	4.6	4.6	6.15	7.95	10.85	8.7	5.2	4.8	4.80	4.55	5.55
4	4.2	4.6	4.6	6.2	8.3	10.9	8.55	5.1	4.8	4.70	4.6	5.5
5	4.3	4.6	4.6	6.2	8.5	11.0	8.3	5.0	4.7	4.65	4.6	5.5
6	4.3	4.6	4.6	6.25	8.8	11.1	8.15	5.0	4.6	4.60	4.6	5.5
7	4.3	4.65	4.65	6.25	8.7	11.5	7.9	5.0	4.55	4.5	4.55	5.45
8	4.3	4.65	4.75	6.2	8.55	11.45	7.65	5.0	4.5	4.45	4.55	5.45
9	4.5	4.75	4.8	6.2	8.4	11.0	7.3	4.9	4.45	4.4	4.55	5.45
10	4.65	4.8	4.8	6.15	8.25	10.4	6.95	4.85	4.4	4.4	4.55	5.4
11	4.75	4.8	4.8	6.15	8.0	9.9	6.7	4.75	4.4	4.4	4.55	5.4
12	4.9	4.8	4.85	6.25	7.9	9.8	6.6	4.75	4.4	4.4	4.5	5.3
13	4.95	4.85	4.85	6.4	7.9	10.0	6.5	4.7	4.4	4.35	4.5	5.3
14	5.0	4.85	4.9	6.7	7.95	10.35	6.4	4.7	4.35	4.35	4.55	5.2
15	5.0	4.9	5.0	7.0	8.0	10.45	6.2	4.6	4.3	4.35	4.75	5.0
16	5.0	4.9	5.2	7.15	8.0	10.5	6.1	4.55	4.3	4.3	4.9	4.8
17	5.1	4.95	5.2	7.3	8.0	10.65	6.05	4.5	4.3	4.3	5.15	4.8
18	5.2	4.95	5.25	7.4	8.0	10.75	5.95	4.5	4.25	4.3	5.35	4.8
19	5.45	5.0	5.25	7.4	8.0	10.8	5.8	4.5	4.2	4.3	5.5	4.8
20	5.9	5.0	5.2	7.4	8.2	10.6	5.7	4.5	4.2	4.35	5.65	4.7
21	6.5	5.0	5.3	7.3	8.5	10.15	5.65	4.5	4.2	4.35	6.3	4.7
22	6.7	5.0	5.4	7.2	8.95	9.7	5.55	4.5	4.15	4.35	7.85	4.7
23	6.9	4.9	5.45	7.2	9.0	9.55	5.4	4.5	4.15	4.35	8.50	4.7
24	6.0	4.85	5.5	7.3	9.15	9.35	5.4	4.45	4.15	4.4	10.0	4.6
25	5.5	4.75	5.5	7.5	9.25	9.25	5.3	4.45	4.1	4.4	8.0	4.6
26	5.1	4.75	5.55	7.75	9.5	9.1	5.4	4.45	4.25	4.4	7.2	4.5
27	5.0	4.7	5.6	8.0	9.7	9.0	5.4	4.4	4.4	4.4	6.9	4.5
28	5.0	4.7	5.65	8.1	9.9	8.95	5.55	4.4	4.55	4.4	6.6	4.5
29	5.0	.....	5.75	8.0	10.2	8.8	5.6	4.4	4.7	4.45	6.4	4.4
30	4.8	.....	5.75	7.9	10.2	8.7	5.5	4.4	4.8	4.45	6.15	4.4
31	4.8	.....	5.8	.....	10.5	.....	5.4	4.55	.....	4.50	.....	.....

Daily discharge, in second-feet, of Payette River near Horseshoe Bend, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,100	1,760	1,700	3,500	7,320	16,800	10,400	2,590	1,640	1,900	1,460	3,600
2	1,140	1,760	1,700	3,780	7,580	16,800	10,300	2,590	1,830	1,900	1,460	3,120
3	1,140	1,580	1,580	4,180	8,500	17,300	10,600	2,430	1,830	1,830	1,520	3,030
4	1,140	1,580	1,580	4,290	9,470	17,500	10,200	2,270	1,830	1,700	1,580	2,940
5	1,240	1,580	1,580	4,290	10,000	17,800	9,470	2,120	1,700	1,640	1,580	2,940
6	1,240	1,580	1,580	4,400	10,900	18,100	9,050	2,120	1,580	1,580	1,580	2,940
7	1,240	1,640	1,640	4,400	10,600	19,500	8,360	2,120	1,520	1,460	1,520	2,850
8	1,240	1,640	1,760	4,290	10,200	19,300	7,710	2,120	1,460	1,400	1,520	2,850
9	1,460	1,760	1,830	4,290	9,750	17,800	6,820	1,970	1,400	1,350	1,520	2,850
10	1,640	1,830	1,830	4,180	9,330	15,800	5,960	1,900	1,350	1,350	1,520	2,760
11	1,760	1,830	1,830	4,180	8,630	14,200	5,380	1,760	1,350	1,350	1,520	2,760
12	1,970	1,830	1,900	4,400	8,360	13,900	5,150	1,760	1,350	1,350	1,460	2,590
13	2,040	1,900	1,900	4,710	8,360	14,600	4,930	1,700	1,350	1,300	1,460	2,590
14	2,120	1,900	1,970	5,380	8,500	15,700	4,710	1,700	1,300	1,300	1,520	2,430
15	2,120	1,970	2,120	6,080	8,630	16,000	4,290	1,580	1,240	1,300	1,760	2,120

Daily discharge, in second-feet, of Payette River near Horseshoe Bend, Idaho, for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2,120	1,970	2,430	6,440	8,630	16,200	4,080	1,520	1,240	1,240	1,970	1,830
17	2,270	2,040	2,430	6,820	8,630	16,600	3,980	1,460	1,240	1,240	2,350	1,830
18	2,430	2,040	2,510	7,070	8,630	17,000	3,780	1,460	1,190	1,240	2,680	1,830
19	2,850	2,120	2,510	7,070	8,630	17,100	3,500	1,460	1,140	1,240	2,940	1,830
20	3,690	2,120	2,430	7,070	9,190	16,500	3,310	1,460	1,140	1,300	3,220	1,700
21	4,930	2,120	2,590	6,820	10,000	15,000	3,220	1,460	1,140	1,300	4,500	1,700
22	5,380	2,120	2,760	6,570	11,300	13,600	3,030	1,460	1,100	1,300	8,230	1,700
23	5,840	1,970	2,850	6,570	11,500	13,100	2,760	1,460	1,100	1,300	10,000	1,700
24	3,880	1,900	2,940	6,820	11,900	12,500	2,760	1,400	1,100	1,350	14,600	1,580
25	2,940	1,760	2,940	7,320	12,200	12,200	2,590	1,400	1,050	1,350	8,630	1,580
26	2,270	1,760	3,030	7,970	13,000	11,800	2,760	1,400	1,190	1,350	6,570	1,460
27	2,120	1,700	3,120	8,630	13,600	11,500	2,760	1,350	1,350	1,350	5,840	1,460
28	2,120	1,700	3,220	8,910	14,200	11,300	3,030	1,350	1,520	1,350	5,150	1,460
29	2,120	.....	3,400	8,630	15,200	11,000	3,120	1,350	1,700	1,400	4,710	1,350
30	1,830	.....	3,400	8,360	15,200	10,600	2,940	1,350	1,830	1,400	4,180	1,350
31	1,830	.....	3,500	.....	16,200	.....	2,760	1,520	.....	1,460	.....	1,350

NOTE.—These discharges are based on a rating curve that is well defined between 1,000 and 13,000 second-feet.

Monthly discharge of Payette River near Horseshoe Bend, Idaho, for 1909.

[Drainage area, 2,240 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	5,840	1,100	2,300	1.03	1.19	141,000	A.
February	2,120	1,580	1,840	.821	.85	102,000	A.
March	3,500	1,580	2,340	1.04	1.20	144,000	A.
April	8,910	3,500	5,910	2.64	2.94	352,000	A.
May	16,200	7,320	10,500	4.69	5.41	646,000	A.
June	19,500	10,600	15,200	6.79	7.58	904,000	A.
July	10,600	2,590	5,280	2.36	2.72	325,000	A.
August	2,590	1,350	1,730	.772	.89	106,000	A.
September	1,830	1,050	1,390	.621	.69	82,700	A.
October	1,900	1,240	1,420	.634	.73	87,300	A.
November	14,600	1,460	3,620	1.62	1.81	215,000	A.
December	3,600	1,350	2,200	.982	1.13	135,000	A.
The year	19,500	1,050	4,480	2.00	27.14	3,240,000	

NORTH FORK OF PAYETTE RIVER DRAINAGE BASIN.

NORTH FORK OF PAYETTE RIVER AT LARDO, IDAHO.

This station was established August 25, 1908, to determine the amount of water available for storage on Big Payette Lake.

On this date a temporary gage was established about 1¼ miles below the lake outlet and was about the same distance from the Lardo post office. This gage was read from September 1 to October 8, 1908. On October 14, 1908, a permanent vertical staff gage was installed on the left bank one-fourth mile below the lake outlet.

A car and cable equipment from which discharge measurements are made is located about half a mile below the gage.

Discharge measurements of North Fork of Payette River at Lardo, Idaho, in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Aug. 25[a]	E. C. La Rue	82	119	2.20	63
Nov. 24	....do	66	104	[b] 2.54	135
1909.					
Sept. 25	W. M. O'Neill	61.8	78	2.03	61.0
Nov. 16	O'Neill and Hartwell	103	123	2.46	146

[a] Measurement made from small ferryboat one-half mile below temporary gage.
[b] Old gage read 2.47′.

Daily gage height, in feet, of North Fork of Payette River at Lardo, Idaho, for 1909.

[Neal Boydstun, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	2.6	2.5	2.4	3.15	6.0	4.5	3.0	2.15	2.02	2.21	3.4
2	2.35	2.6	2.5	2.4	3.1	6.4	4.4	3.0	2.15	1.98	2.25	3.35
3	2.4	2.6	2.5	2.45	3.2	6.8	4.4	2.95	2.15	1.98	2.28	3.3
4	2.4	2.6	2.5	2.5	3.4	7.2	4.35	2.9	2.15	1.99	2.32	3.0
5	2.4	2.6	2.5	2.5	3.7	7.5	4.2	2.85	2.15	2.00	2.36	3.05
6	2.4	2.6	2.5	2.5	3.8	7.0	4.1	2.8	2.15	2.01	2.4	3.1
7	2.4	2.6	2.5	2.5	3.8	6.5	4.0	2.75	2.15	2.03	2.4	3.1
8	2.4	2.6	2.5	2.5	3.9	6.3	3.9	2.7	2.15	2.05	2.45	3.1
9	2.45	2.55	2.5	2.5	4.1	5.8	3.8	2.65	2.15	2.07	2.47	3.1
10	2.45	2.5	2.5	2.5	4.2	5.7	3.7	2.6	2.15	2.08	2.5	3.05
11	2.45	2.5	2.45	2.55	4.1	5.5	3.65	2.55	2.15	2.08	2.5	3.05
12	2.45	2.5	2.45	2.55	4.15	5.4	3.5	2.5	2.15	2.09	2.48	3.05
13	2.45	2.55	2.4	2.55	4.0	5.0	3.45	2.45	2.15	2.09	2.47	3.0
14	2.45	2.6	2.4	2.6	4.0	5.15	3.4	2.4	2.1	2.09	2.45	3.0
15	2.5	2.6	2.4	2.65	4.1	5.5	3.3	2.4	2.1	2.1	2.45	2.95
16	2.5	2.6	2.4	2.7	4.2	6.0	3.25	2.4	2.1	2.1	2.45	2.9
17	2.5	2.6	2.4	2.7	4.25	6.1	3.2	2.4	2.1	2.1	2.45	2.85
18	2.55	2.6	2.4	2.75	4.3	6.15	3.15	2.4	2.05	2.1	2.45	2.8
19	2.55	2.6	2.4	2.8	4.35	6.2	3.1	2.35	2.05	2.1	2.5	2.75
20	2.6	2.6	2.4	2.85	4.4	6.2	3.0	2.35	2.05	2.1	2.55	2.75
21	2.6	2.55	2.4	2.9	4.5	5.7	2.95	2.35	2.05	2.1	2.55	2.7
22	2.7	2.55	2.4	2.95	4.6	5.5	2.9	2.35	2.05	2.1	2.75	2.65
23	2.7	2.5	2.4	3.0	4.6	5.3	2.9	2.3	2.05	2.1	3.05	2.65
24	2.7	2.5	2.4	3.0	4.65	5.2	2.85	2.3	2.05	2.1	3.8	2.65
25	2.7	2.5	2.4	3.1	4.7	5.0	2.8	2.25	2.04	2.1	3.8	2.6
26	2.7	2.5	2.4	3.15	4.8	4.75	2.85	2.2	2.04	2.1	3.78	2.6
27	2.7	2.5	2.4	3.3	5.2	4.6	2.9	2.2	2.04	2.19	3.76	2.6
28	2.7	2.5	2.4	3.2	5.4	4.6	3.0	2.15	2.04	2.18	3.75	2.6
29	2.65	.....	2.4	3.1	5.6	4.5	3.1	2.15	2.04	2.18	3.65	2.55
30	2.6	.....	2.4	3.15	5.6	4.5	3.15	2.15	2.03	2.18	3.5	2.55
31	2.6	.....	2.4	.....	5.7	.....	3.1	2.15	.....	2.18	.....	2.6

Daily discharge, in second-feet, of North Fork of Payette River at Lardo, Idaho, for 1908.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	65	35	154	142	11	40	54	154	130
2	65	35	180	142	12	50	60	154	130
3	60	35	180	142	13	50	67	154	142
4	60	35	180	142	14	50	74	154	142
5	50	35	180	142	15	50	110	154	142
6	50	35	180	130	16	50	130	154	130
7	50	35	180	130	17	50	130	154	130
8	50	35	180	130	18	50	154	154	130
9	50	41	154	130	19	50	154	154	130
10	40	48	154	130	20	50	154	154	120

Daily discharge, in second-feet, of North Fork of Payette River at Lardo, Idaho, for 1908—Continued.

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
21	50	154	154	120	26	40	154	154	120
22	50	154	154	120	27	40	154	154	120
23	40	154	167	120	28	35	154	154	120
24	40	154	167	120	29	35	154	142	120
25	40	154	154	120	30	35	154	142	120
					31	.....	154	.....	120

NOTE.—Daily discharges Sept. 1 to Oct. 8, 1908, are based on discharge measurements made during 1908. Discharge for period Oct. 9-13 interpolated. Daily discharges Oct. 14, 1908, to Dec. 31, 1909, based on curve which is fairly well defined at high and low stages.

Daily discharge, in second-feet, of North Fork of Payette River at Lardo, Idaho, for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	120	180	154	130	386	2,750	1,300	324	82	63	92	510
2	120	180	154	130	364	3,150	1,210	324	82	58	100	484
3	130	180	154	142	408	3,550	1,210	304	82	58	106	458
4	130	180	154	154	510	3,950	1,170	284	82	59	114	324
5	130	180	154	154	688	4,250	1,050	265	82	60	122	344
6	130	180	154	154	754	3,750	972	246	82	61	130	364
7	130	180	154	154	754	3,250	896	228	82	64	130	364
8	130	180	154	154	824	3,050	824	210	82	67	142	364
9	142	167	154	154	972	2,550	754	195	82	70	147	364
10	142	154	154	154	1,050	2,450	688	180	82	71	154	344
11	142	154	142	167	972	2,250	657	167	82	71	154	344
12	142	154	142	167	1,010	2,150	566	154	82	73	149	344
13	142	167	130	167	896	1,760	538	142	82	73	147	324
14	142	180	130	180	896	1,900	510	130	74	73	142	324
15	154	180	130	195	972	2,250	458	130	74	74	142	304
16	154	180	130	210	1,050	2,750	433	130	74	74	142	284
17	154	180	130	210	1,090	2,850	408	130	74	74	142	265
18	167	180	130	228	1,130	2,900	386	130	67	74	142	246
19	167	180	130	246	1,170	2,950	364	120	67	74	154	228
20	180	180	130	265	1,210	2,950	324	120	67	74	167	228
21	180	167	130	284	1,300	2,450	304	120	67	74	167	210
22	210	167	130	304	1,390	2,250	284	120	67	74	228	195
23	210	154	130	324	1,390	2,050	284	110	67	74	344	195
24	210	154	130	324	1,430	1,950	265	110	67	74	754	195
25	210	154	130	364	1,480	1,760	246	100	66	74	754	180
26	210	154	130	386	1,570	1,520	265	90	66	74	741	180
27	210	154	130	458	1,950	1,390	284	90	66	88	728	180
28	210	154	130	408	2,150	1,390	324	82	66	87	721	180
29	195	.....	130	364	2,350	1,300	364	82	66	87	657	167
30	180	.....	130	386	2,350	1,300	386	82	64	87	566	167
31	180	.....	130	.....	2,450	.....	364	82	.....	87	.....	180

Monthly discharge of North Fork of Payette River near Lardo, Idaho, for 1908.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
September	65	35	47.8	2,840	B.
October	154	35	102	6,270	B.
November	180	142	160	9,520	B.
December	142	120	129	7,930	B.

Monthly discharge of North Fork of Payette River at Lardo, Idaho, for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	210	120	163	10,000	B.
February	180	154	170	9,440	B.
March	154	130	139	8,550	B.
April	458	130	237	14,100	B.
May	2,450	364	1,190	73,200	B.
June	4,250	1,300	2,490	148,000	B.
July	1,300	246	583	35,800	B.
August	324	82	161	9,900	A.
September	82	64	74.2	4,420	A.
October	88	58	72.4	4,450	A.
November	754	92	279	16,600	A.
December	510	167	285	17,500	B.
The year	4,250	58	487	352,000	

LAKE FORK OF PAYETTE RIVER NEAR M'CALL, IDAHO.

This station, which was established September 28, 1909, to determine the amount of water available for a proposed Carey Act project on the Lake Fork of Payette River, is located in sec. 13, T. 18 N., R. 3 E., at Waini's ranch, about 1 mile below Little Payette Lake and about 5 miles from McCall post office.

One small creek enters between this station and the outlet of the lake. There are no diversions above, but a small canal heads about one-quarter mile below the staff gage.

The gage heights are very little affected by ice and not at all by artificial control above, but will at times show the effect of backwater from the dam at the head of the irrigation canal below.

High-water measurements will be made from a cable equipment located about 200 feet below the gage. Low-water discharge measurements can be made by wading about one-fourth mile upstream from the gage.

A good rating covering the range of 1909 gage heights has been obtained.

Discharge measurements of Lake Fork of Payette River near McCall, Idaho, in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 28	W. M. O'Neill	43.5	30.7	0.86	27.6
Nov. 18	do	64	60.7	1.38	62.3

NOTE.—These measurements were made by wading.

Daily gage height, in feet, and discharge, in second-feet, of Lake Fork of Payette River near McCall, Idaho, for 1909.

[Andrew Waini, observer.]

Day.	September.		October.		November.		December.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			1.2	49	1.2	49	2.2	140
2			1.2	49	1.35	60	2.5	175
3			1.25	52	1.85	104	1.9	109
4			1.3	56	1.85	104	1.9	109
5			1.3	56	1.85	104	1.9	109
6			1.3	56	1.75	94	1.9	109
7			1.45	68	1.7	90	1.85	104
8			1.45	68	1.65	86	1.85	104
9			1.4	64	1.65	86	1.85	104
10			1.5	72	1.6	81	1.85	104
11			1.35	60	1.6	81	1.95	114
12			1.3	56	1.55	76	1.8	99
13			1.4	64	1.5	72	1.7	90
14			1.2	49	1.4	64	1.7	90
15			1.25	52	1.4	64	1.65	86
16			1.2	49	1.4	64	1.45	68
17			1.15	46	1.4	64	1.55	76
18			1.1	42	1.4	64	1.55	76
19			1.1	42	1.5	72	1.55	76
20			1.15	46	1.7	90	1.5	72
21			1.15	46	1.5	72	1.5	72
22			1.1	42	2.05	124	1.5	72
23			1.15	46	2.95	224	1.5	72
24			1.1	42	3.1	253	1.5	72
25			1.1	42	3.5	308	1.5	72
26			1.1	42	3.1	253	1.5	72
27			1.1	42	2.9	217	1.5	72
28	.85	28	1.1	42	2.45	169	1.5	72
29	1.00	36	1.15	46	2.35	157	1.4	64
30	1.15	46	1.15	46	2.25	146	1.4	64
31				48			1.4	64

NOTE.—These discharges are based on a rating curve that is well defined below 100 second-feet.

Monthly discharge of Lake Fork of Payette River near McCall, Idaho, for 1909.

Months.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
October	72	42	51.0	3,140	A.
November	308	49	116	6,900	A.
December	175	64	89.7	5,520	A.

POWDER RIVER DRAINAGE BASIN.

DESCRIPTION.

Powder River, which drains the eastern slope of the Blue Mountains, rises in the extreme western portion of Baker County, flows east, then north through Baker City to the town of North Powder, where it turns abruptly to the southeast and empties into Snake River in the east-central part of Baker County.

The general elevation of the headwaters is 6,000 feet above sea level, while that of the valley is 3,300 feet. Sumpter is 4,415 feet above sea level, and Baker City, 3,586 feet. The only important tributary stream is Eagle Creek, which drains the southern part of the Powder River Mountains and empties into the Powder near its mouth. The total drainage area of Powder River at the mouth is 1,660 square miles; at Baker City it is 341 square miles.

At the headwaters the country is mountainous and heavily forested and the principal industry is mining and lumbering. The valley of the Powder has not been greatly developed, although a number of irrigation ditches are in operation. Any extensive development will involve the construction of storage reservoirs, for which facilities are not lacking.

The mean annual rainfall at Baker City is 15 inches; in the headwater region it is probably twice that amount, the greater part falling during the winter in the form of snow. The determination of stream flow in this area is rendered somewhat difficult during the winter, as the streams are icebound for weeks at a time.

POWDER RIVER AT SALISBURY, OREG.

This station, which was established December 20, 1903, is located 10 miles above Baker City and one-fourth mile below Salisbury, a station on the Sumpter Valley Railroad. It is above all important diversions for the Powder River valley.

The data are of considerable practical value, as the waters are used for mining above the station and for irrigation below. They are also of scientific interest, because this drainage area was once quite heavily forested, but is being rapidly logged off.

A small ditch diverts water about one-fourth mile above the gage. This ditch carries considerable water during the spring and early summer, but its percentage to the flow in the river is small. The observer increases his readings by 0.1 foot to allow for this. On October 10, 1909, the ditch carried 0.5 second-foot.

The vertical staff gage is on the left bank, about 40 feet above a wagon bridge, from which discharge measurements are made. The gage datum has remained unchanged.

The daily discharge of the river is affected somewhat by placer mining operations upstream. During the spring and fall the gage heights are affected by melting snow from the Blue Mountains, the afternoon gage heights being always higher than the morning readings. During the winter months the stream frequently remains frozen for long periods. Although an attempt has been made to develop rating curves for ice conditions, the results have not been very satisfactory.

Discharge measurements of Powder River at Salisbury, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet*	*Sec.-ft.*
Mar. 11	H. D. McGlashan	40	33	2.45	75
11	do	33	18	2.05	29
July 15	R. B. Post	38	25	2.22	45
Oct. 10[a]	F. F. Henshaw	18.5	15.6	1.91	[b]13.4

[a] Made by wading at gage. [b] Includes 0.5 second-foot for ditch diversion above gage.

Daily gage height, in feet, of Powder River at Salisbury, Oreg., for 1909.

[R. M. Garrett, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.05	2.6	2.45	3.0	3.15	4.35	2.4	2.0	1.15	1.7	1.85	2.85
2	2.1	2.6	2.35	3.45	3.15	4.45	2.3	2.0	1.3	1.7	1.85	2.85
3	2.05	2.45	2.35	3.3	3.3	4.35	2.35	1.95	1.4	1.85	1.9	2.65
4	2.0	2.35	2.45	3.15	3.45	4.15	2.35	1.95	1.35	1.85	2.10	2.6
5	1.95	2.35	2.45	3.35	3.55	4.25	2.4	1.85	1.3	1.9	2.18	2.6
6	1.95	2.25	2.35	3.25	3.5	4.35	2.35	1.85	1.35	1.8	2.18	2.3
7	1.85	2.25	2.35	3.15	3.7	4.25	2.4	1.8	1.35	1.75	2.25	2.45
8	1.85	2.2	2.45	3.05	3.55	4.25	2.35	1.9	1.35	1.75	2.25	2.5
9	1.85	2.2	2.35	3.0	3.65	4.1	2.25	1.9	1.35	1.75	2.3	2.3
10	1.8	2.3	2.25	3.0	3.75	3.85	2.25	1.8	1.35	1.75	2.35	2.25
11	1.8	2.35	2.25	3.0	3.65	3.85	2.25	1.75	1.25	1.8	2.45	2.2
12	1.8	2.35	2.35	2.95	3.55	3.75	2.2	1.65	1.25	1.9	2.45	2.15
13	1.85	2.45	2.45	2.95	3.4	3.65	2.2	1.6	1.2	1.85	2.5	2.15
14	1.95	2.45	2.95	3.05	3.35	3.45	2.2	1.6	1.2	1.75	2.5	2.15
15	2.05	2.45	2.9	3.2	3.3	3.4	2.15	1.6	1.35	1.85	2.6	2.2
16	2.15	2.55	2.95	3.05	3.25	3.25	2.05	1.45	1.35	1.85	2.6	2.15
17	2.3	2.45	2.95	3.05	3.4	3.25	2.1	1.5	1.35	1.85	2.65	2.0
18	2.35	2.35	2.9	3.15	3.3	3.1	2.05	1.5	1.4	1.85	2.75	2.0
19	2.45	2.35	2.8	3.15	3.25	3.2	2.0	1.6	1.35	1.85	2.78	2.05
20	2.35	2.3	2.95	3.05	3.35	3.1	2.1	1.55	1.3	1.95	2.85	1.95
21	2.55	2.25	3.05	3.05	3.35	3.05	2.1	1.45	1.35	2.05	2.9	1.95
22	3.1	2.25	3.15	3.05	3.4	2.95	2.0	1.4	1.4	2.05	2.95	1.9
23	3.5	2.35	3.05	3.15	3.45	2.95	2.05	1.4	1.5	2.1	3.2	1.85
24	3.3	2.4	2.95	3.15	3.5	2.9	2.05	1.3	1.55	2.05	3.15	1.8
25	3.1	2.45	3.05	3.0	3.45	2.8	2.0	1.3	1.6	2.1	3.25	1.75
26	3.05	2.4	3.15	3.0	3.35	2.7	2.0	1.3	1.55	2.1	3.1	1.7
27	3.05	2.4	3.5	3.1	3.55	2.65	1.9	1.2	1.6	2.05	3.15	1.7
28	2.9	2.4	3.7	3.15	3.65	2.7	1.9	1.25	1.55	2.05	3.15	1.7
29	2.85	.....	3.65	3.2	3.75	2.65	1.85	1.2	1.65	2.05	3.05	1.8
30	2.8	.....	3.4	3.15	3.95	2.65	1.9	1.25	1.65	2.1	3.05	1.8
31	2.75	.....	3.3	.....	4.15	.....	1.9	1.1	.....	2.12	.....	1.7

NOTE.—Ice conditions Jan. 1 to 16 and Dec. 10 to 31. Ice 6 to 8 inches thick during the period.

Daily discharge, in second-feet, of Powder River at Salisbury, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	22	97	72	175	210	590	65	23	0.1	6.4	13	144
2	25	97	58	286	210	630	52	23	.5	6.4	13	144
3	22	72	58	247	247	590	58	20	1.0	13	16	106
4	18	58	72	210	286	514	58	20	.8	13	31	97
5	16	58	72	260	315	542	65	13	.5	16	39	97
6	16	46	58	234	300	590	58	13	.8	13	39	52
7	10	46	58	210	361	542	65	10	.8	8.2	46	72
8	10	41	72	186	315	542	58	16	.8	8.2	46	80
9	10	41	58	175	346	496	46	16	.8	8.2	52	52
10	8	52	46	175	377	410	46	10	.8	8.2	58	37
11	8	58	46	175	346	410	46	8.2	.4	10	72	33
12	8	58	58	164	315	377	41	5.0	.4	16	72	29
13	10	72	72	164	273	346	41	3.7	.2	13	80	29
14	16	72	164	186	260	286	41	3.7	.2	8.2	80	29
15	22	72	154	222	247	273	38	3.7	.8	13	97	33

Daily discharge, in second-feet, of Powder River at Salisbury, Oreg., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	29	88	164	186	234	234	27	1.5	.8	13	97	29
17	52	72	164	186	273	234	31	2.0	.8	13	106	18
18	58	58	154	210	247	198	27	2.0	1.0	13	124	18
19	72	58	134	210	234	222	23	3.7	.8	13	130	22
20	58	52	164	186	260	198	31	2.8	.5	20	144	16
21	88	46	186	186	260	186	31	1.5	.8	27	154	16
22	198	46	210	186	273	164	23	1.0	1.0	27	164	13
23	300	58	186	210	286	164	27	1.0	2.0	31	222	10
24	247	65	164	210	300	154	27	.5	2.8	27	210	8
25	198	72	186	175	286	134	23	.5	3.7	31	234	6.6
26	186	65	210	175	260	115	23	.5	2.8	31	198	5.1
27	186	65	300	198	315	106	16	.2	3.7	27	210	5.1
28	154	65	361	210	346	115	16	.4	2.8	27	210	5.1
29	144	.....	346	222	377	106	13	.2	5.0	27	186	8
30	134	.....	273	210	443	106	16	.4	5.0	31	186	8
31	124	.....	247	.....	514	.....	16	.....	.....	33	.....	5.1

NOTE.—These discharges are based on a rating curve that is fairly well defined.
Discharges from Jan. 1 to 16 and Dec. 10 to 31 have been reduced 20 per cent to allow for ice conditions.

Monthly discharge of Powder River at Salisbury, Oreg., for 1909.

[Drainage area, 230 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	300	8	79.0	0.343	0.40	4,860	C.
February	97	41	62.5	.272	.28	3,470	B.
March	361	46	147	.639	.74	9,040	A.
April	286	164	201	.874	.98	12,000	A.
May	514	210	301	1.31	1.51	18,500	A.
June	630	106	319	1.39	1.55	19,000	A.
July	65	13	37	.161	.19	2,280	A.
August	23	0	6.66	.029	.03	410	C.
September	5	0.1	1.41	.0061	.007	84	D.
October	33	6.4	17.8	.077	.09	1,090	B.
November	234	13	111	.483	.54	6,600	B.
December	144	5.1	39.6	.172	.20	2,430	D.
The year	630	0	110	.480	6.52	79,800	

POWDER RIVER NEAR NORTH POWDER, OREG.

This station, which was established March 9, 1909, is located at the dam site in the lower end of Thief Valley, 7 miles east of North Powder, Oreg. A large irrigation project is proposed whereby the waters of Powder River will be stored above this point and used for the reclamation of approximately 40,000 acres of land.

About 1 mile above the station a temporary dam is constructed each year that raises the water to a sufficient height to subirrigate the adjoining lands. For this reason the river is under more or less artificial control during the extreme low-water period.

The gage, which consists of an inclined low-water section and a vertical section, is located in the measuring section at the cable. Discharge measurements are made from a standard cable equipment. The bed of the stream is of bowlders and gravel and is not likely to change except in extreme high water. Both banks are high and will not overflow.

Discharge measurements of Powder River near North Powder, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet.*	*Sec.-feet.*
Mar. 9	H. D. McGlashan	58	87	2.35	201
July 17	R. B. Post	39	35	1.48	36
Sept. 29	O. C. Finkelnburg	29	27	1.25	20.9
Oct. 10	F. F. Henshaw	29	27	1.22	18.6

Daily gage height, in feet, of Powder River near North Powder, Oreg., for 1909.

[W. C. Fisk, observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.90	1.90	3.80	2.00	1.35	1.05	1.40	1.59	.....
2	.....	2.90	1.80	4.60	1.92	1.32	1.05	1.45	1.60	.....
3	.....	2.90	1.75	5.30	1.87	1.27	1.10	1.46	1.65	.....
4	.....	2.94	1.70	5.15	1.84	1.25	1.20	1.48	1.70	.....
5	.....	2.95	1.80	4.83	1.80	1.23	1.28	1.49	1.73	.....
6	.....	2.90	1.73	5.20	1.75	1.22	1.35	1.49	1.60	.....
7	.....	2.80	1.73	4.80	1.73	1.22	1.33	1.50	1.64	.....
8	.....	2.74	1.69	3.80	1.69	1.22	1.32	1.50	1.68	.....
9	2.35	2.52	1.70	3.78	1.68	1.22	1.30	1.50	1.68	.....
10	2.32	2.54	1.70	3.55	1.68	1.20	1.29	1.50	1.64	.....
11	2.20	2.50	1.71	3.25	1.66	1.20	1.30	1.50	1.60	.....
12	2.20	2.35	1.70	3.20	1.65	1.20	1.30	1.50	1.60	.....
13	2.20	2.30	1.75	3.50	1.65	1.19	1.30	1.50	1.60	.....
14	2.20	2.34	1.73	3.60	1.63	1.18	1.29	1.45	1.60	.....
15	2.20	2.35	1.65	3.55	1.60	1.18	1.29	1.45	1.62	.....
16	2.25	2.40	.....	3.45	1.45	1.15	1.29	1.45	1.58	.....
17	2.30	2.42	.....	3.50	1.42	1.14	1.30	1.40	1.55	.....
18	2.40	2.40	.....	3.60	1.43	1.13	1.27	1.22	1.53	.....
19	2.51	2.35	.....	3.65	1.43	1.12	1.24	1.45	1.60	.....
20	2.51	2.38	.....	3.65	1.43	1.10	1.20	1.48	1.65	.....
21	2.51	2.35	.....	3.60	1.40	1.10	1.20	1.50	1.80	.....
22	2.44	2.34	.....	3.50	1.37	1.10	1.20	1.51	1.90	.....
23	2.5	2.30	1.61	3.20	1.35	1.10	1.20	1.50	1.95	.....
24	2.51	2.20	1.60	2.90	1.30	1.10	1.20	1.48	2.30	.....
25	2.5	2.20	1.57	2.70	1.25	1.10	1.20	1.50	3.10	.....
26	2.51	2.18	1.55	2.40	1.30	1.09	1.20	1.48	2.80	2.50
27	2.52	2.12	1.60	2.40	1.40	1.09	1.30	1.48	2.50	2.40
28	2.7	2.10	2.85	2.30	1.38	1.08	1.33	1.52	2.30	2.50
29	2.74	2.09	3.10	2.20	1.37	1.08	1.36	1.52	2.40	2.60
30	2.75	2.00	3.40	2.15	1.37	1.05	1.38	1.55	2.50	2.40
31	2.8	.....	3.60	.....	1.37	1.05	.....	1.57	.....	2.50

NOTE.—Ice conditions from about Nov. 8 to Dec. 31.

Daily discharge, in second-feet, of Powder River near North Powder, Oreg., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	343	94	606	115	27	12	30	47	200
2	.....	343	76	864	98	25	12	34	48	200
3	.....	343	68	1,100	89	22	13	35	54	200
4	.....	354	61	1,050	83	21	18	36	61	200
5	.....	356	76	942	76	20	23	37	66	200
6	.....	343	66	1,070	68	19	27	37	48	200
7	.....	317	66	932	66	19	26	38	53	200
8	.....	301	60	606	60	19	25	38	44	200
9	200	244	61	600	58	19	24	38	44	200
10	192	249	61	529	58	18	23	38	40	200
11	163	239	62	440	56	18	24	38	36	200
12	163	200	61	426	54	18	24	38	36	200
13	163	187	68	514	54	18	24	38	36	200
14	163	197	63	544	52	17	23	34	36	200
15	163	200	54	529	48	17	23	34	38	200

Daily discharge, in second-feet, of Powder River near North Powder, Oreg., for 1909—Continued.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	175	213	53	499	34	16	23	34	34	200
17	187	218	53	514	32	15	24	30	32	200
18	213	213	52	544	32	14	22	19	31	200
19	242	200	52	559	32	14	20	34	36	200
20	242	208	51	559	32	13	18	36	41	200
21	242	200	50	544	30	13	18	38	57	200
22	223	197	50	514	28	13	18	39	70	200
23	239	187	49	426	27	13	18	38	104	200
24	242	163	48	343	24	13	18	36	187	200
25	239	163	45	291	21	13	18	38	398	200
26	242	158	43	213	24	13	18	36	317	179
27	244	144	48	213	30	13	24	36	239	160
28	291	139	330	187	29	12	26	40	187	179
29	301	137	398	163	28	12	28	40	213	199
30	304	115	484	151	28	12	29	43	239	160
31	317	.....	544	.....	28	12	.....	45	.....	179

NOTE.—These discharges are based on a curve that is well defined.
Discharges from Nov. 8 to 22 and Dec. 26 to 31 reduced 25 per cent to allow for ice conditions. Dec. 1 to 25 discharge estimated. Discharges May 16 to 22 interpolated.

Monthly discharge of Powder River near North Powder, Oreg., for 1909.

[Drainage area, 826 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March 9-31	317	163	224	0.271	0.23	10,200	A.
April	356	115	229	.277	.31	13,600	A.
May	544	43	108	.131	.15	6,640	A.
June	1,100	151	549	.665	.74	32,700	A.
July	115	21	48.2	.058	.07	2,960	A.
August	27	12	16.4	.020	.02	1,010	A.
September	29	12	21.4	.026	.03	1,270	A.
October	45	19	36.3	.044	.05	2 230	A.
November	398	31	95.7	.116	.13	5,690	C.
December	200	160	195	.236	.27	12,000	D.
The period	.....	.....	.....	.....	.....	88,300	

EAGLE CREEK NEAR BAKER CITY, OREG.

This station, which is located 700 feet below the confluence of West Eagle Creek with Eagle Creek, and about 35 miles northeast of Baker City, was established May 20, 1909, by O. C. Finkelnburg, who cooperates with the Geological Survey in maintaining the station.

The data obtained at this station will be valuable in connection with the irrigation of lands in the Powder River valley, into which the waters can be diverted.

The gage is a vertical staff, graduated in feet and tenths, on the right bank, 5 feet upstream from the measuring section. Discharge measurements are made from a suspended footbridge.

The bed of the stream is composed of gravel and cobblestones, and is very rough, but is not likely to change except during extreme high water. Anchor ice will probably affect the determination of winter discharge to a small extent.

Discharge measurements of Eagle Creek near Baker City, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 20	O. C. Finkelnburg	48	82	2.90	438
Aug. 3	do	32	46	2.00	113
Sept. 27	do	28	20	1.40	32

Daily gage height, in feet, of Eagle Creek near Baker City, Oreg., for 1909.

[Ed. Hoskinson, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1		3.6	3.15	2.05	1.6	16		3.5	2.45	1.7	1.25
2		3.88	3.1	2.0	1.6	17		3.42	2.4	1.68	1.2
3		3.85	3.18	1.98	1.55	18		3.45	2.32	1.68	1.2
4		3.88	3.08	1.95	1.55	19		3.52	2.25	1.68	1.25
5		3.7	2.92	1.95	1.55	20	3.2	3.42	2.18	1.68	1.25
6		3.65	2.8	1.88	1.55	21	2.98	3.32	2.18	1.68	1.25
7		3.55	2.65	1.88	1.55	22	2.85	3.15	2.18	1.62	1.3
8		3.42	2.52	1.85	1.5	23	2.78	3.12	2.15	1.6	1.3
9		3.35	2.55	1.82	1.5	24	2.85	3.1	2.12	1.6	1.3
10		3.35	2.6	1.8	1.45	25	3.02	3.12	2.1	1.6	1.35
11		3.42	2.55	1.8	1.45	26	3.1	3.0	2.08	1.62	1.35
12		3.5	2.52	1.75	1.45	27	3.35	3.0	2.28	1.6	1.4
13		3.52	2.5	1.78	1.4	28	3.22	3.08	2.42	1.6	1.45
14		3.55	2.45	1.72	1.35	29	3.1	3.15	2.2	1.6	1.45
15		3.6	2.42	1.72	1.3	30	3.07	3.22	2.12	1.6	
						31	3.3		2.08	1.6	

Daily discharge, in second-feet, of Eagle Creek near Baker City, Oreg., for 1909.

Day.	May.	June.	July.	Aug.	Sept.	Day.	May.	June.	July.	Aug.	Sept.
1		795	565	124	51	16		740	242	63	20
2		949	540	113	51	17		700	225	61	17
3		932	580	109	46	18		715	197	61	17
4		949	530	103	46	19		751	175	61	20
5		850	450	103	46	20	590	700	155	61	20
6		822	390	90	46	21	480	650	155	61	20
7		768	322	90	46	22	415	565	155	53	24
8		700	268	85	41	23	381	550	148	51	24
9		665	280	80	41	24	415	540	140	51	24
10		665	300	77	36	25	500	550	135	51	28
11		700	280	77	36	26	540	490	131	53	28
12		740	268	70	36	27	665	490	184	51	32
13		751	260	74	32	28	600	530	232	51	36
14		768	242	66	28	29	540	565	100	51	36
15		795	232	66	24	30	525	600	140	51	36
						31	640		131	51	

NOTE.—These discharges are based on a rating curve that is fairly well defined below 500 second-feet.

Monthly discharge of Eagle Creek near Baker City, Oreg., for 1909.

Months.	Discharge in second-feet.			Run-off.	Accuracy.
	Maximum.	Minimum.	Mean.	Total in acre-feet.	
May 20-31	665	381	524	12,500	A.
June	949	490	700	41,700	B.
July	580	131	265	16,300	A.
August	124	51	71.3	4,380	A.
September	51	17	32.9	1,960	B.

GRANDE RONDE RIVER DRAINAGE BASIN.

DESCRIPTION.

Grande Ronde River drains the eastern slope of the Blue Mountains in Oregon and the northern slopes of the Powder River Mountains, a comparatively high range that runs at right angles to the Blue Mountain Range. The river rises on the divide in the extreme southern portion of Union County, flows in a northeasterly direction and empties into Snake River at Zindel, Wash., about 12 miles below the Oregon-Washington line. The principal tributaries of the Grande Ronde are Joseph Creek, which drains the Chesnimnus National Forest; the Wallowa, which rises in the Powder Mountains and drains the Wallowa National Forest; and Catherine Creek, which drains the western portion of the Powder Mountains. The drainage area of Grande Ronde River at its mouth is 3,950 square miles. Above the mouth of the Wallowa the drainage area is 1,590 square miles.

The topography of this basin is generally rough, the area being almost entirely surrounded by mountain ranges which slope gradually to Grande Ronde Valley, a large area of agricultural land approximately 2,700 feet above the sea level. The general elevation of the Powder and Blue Mountains, from which the river receives its water supply, is 8,000 feet.

The drainage area of this river, except in the agricultural valleys, is almost entirely forested, a large part being included in the national forests. The mean annual rainfall at La Grande is 19 inches, but on the headwaters of the stream it is probably 35 inches. The greater part of this precipitation occurs during the winter months as snow. The river is subject to an annual spring rise, due to the melting of snow in the mountains, and damaging floods are frequently caused by the sudden melting of snows by chinook winds.

The agricultural activities have in the past been largely confined to the production of wheat, and irrigation has not been extensively practiced, although exceptionally good opportunities are afforded. Only the lower valley lands immediately contiguous to the streams have been irrigated, but there are at present under consideration a number of larger projects that involve the construction of reservoirs

and the irrigation of large areas by means of long canals. Records of the flow of some of the streams in this basin have been kept since 1904.

GRANDE RONDE RIVER AT HILGARD, OREG.

This station, which is located at the county highway bridge, one-half mile below Hilgard station on the Oregon Railroad & Navigation line at the head of Grande Ronde Valley and just below the mouth of Five Points Creek, which is the most important tributary above the Grande Ronde Valley, was established November 6, 1903, to determine the quantity of water available for irrigation.

At this point the river is chiefly used for the transportation of logs, and on this account it has been almost impossible to obtain reliable records of flow. There are a number of dams on the stream, behind which water is impounded and then released in order to carry the logs to their destination. Many times logs ground on the bars below the station, and even in the cross-section where measurements are made, and produce backwater.

The vertical staff gage is fastened to the downstream side of the middle pier of the bridge, from which discharge measurements are made. The gage datum has remained unchanged.

The following discharge measurement was made by F. F. Henshaw:

October 14, 1909: Width, 37.5 feet; area, 33.4 square feet; gage height, 2.83 feet; discharge, 32.3 second-feet.

Daily gage height, in feet, of Grande Ronde River at Hilgard, Oreg., for 1909.

[Owen Scott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	3.1	3.5	4.4	4.6	4.6	3.3	2.8	2.6	3.0	3.0	3.5
2	2.9	3.2	3.8	4.4	4.6	4.8	3.3	2.8	2.8	3.0	3.05	3.5
3	3.0	3.2	3.8	4.4	4.6	4.8	3.2	2.7	2.8	3.0	3.0	3.5
4	3.0	3.2	3.8	4.4	4.6	4.6	3.2	2.7	3.0	3.0	2.9	3.5
5	3.0	3.2	4.2	4.4	4.4	4.4	3.0	2.7	3.0	3.0	3.0	3.4
6	3.0	3.1	3.9	4.4	4.6	4.2	3.0	2.7	3.0	3.1	3.0	3.4
7	3.0	3.1	3.8	4.4	4.4	4.1	3.0	2.6	3.0	3.0	2.9	3.5
8	3.0	3.1	3.8	4.4	4.4	4.1	2.8	2.6	3.0	3.0	2.9	3.8
9	3.0	3.1	3.6	4.2	4.4	4.0	3.0	2.6	3.0	3.0	2.9	4.4
10	3.0	3.1	3.5	4.2	4.6	4.0	3.2	2.6	3.1	3.0	2.9	3.8
11	3.0	3.1	3.4	4.4	4.6	4.0	3.0	2.6	3.2	2.9	2.9	3.8
12	3.0	3.1	3.4	4.4	4.4	3.9	3.0	2.5	3.2	2.9	2.9	4.4
13	3.0	3.2	3.4	4.4	4.4	4.0	3.0	2.5	3.0	2.9	2.9	4.0
14	3.0	3.3	3.6	4.4	4.4	4.0	3.0	2.5	3.0	2.95	2.9	4.05
15	3.0	3.4	3.9	4.4	4.5	4.0	3.0	2.5	3.0	2.95	2.85	4.05
16	3.0	3.8	4.2	4.6	4.4	4.0	2.8	2.4	3.0	2.95	2.8	4.0
17	3.4	3.8	4.2	4.8	4.2	4.0	2.8	2.4	3.0	2.95	2.8	3.8
18	3.6	3.8	4.2	4.6	4.2	3.8	2.8	2.4	3.0	2.95	2.9	3.5
19	3.6	3.8	4.2	4.4	4.1	4.1	2.9	2.4	3.0	2.95	3.0	3.5
20	4.3	3.8	4.2	4.4	4.1	4.0	2.9	2.4	3.0	2.95	3.0	3.4
21	4.7	3.4	4.2	4.4	4.1	3.9	2.9	2.5	3.0	2.95	3.3	3.4
22	3.9	3.2	3.9	4.2	4.1	3.8	2.8	2.5	3.0	2.95	3.3	3.4
23	3.8	3.2	3.9	4.2	4.0	3.6	2.8	2.6	3.0	2.95	3.8	3.4
24	3.6	3.2	3.9	4.2	4.0	3.4	2.7	2.6	3.0	2.95	4.4	3.4
25	3.4	3.2	4.0	4.2	4.0	3.4	2.7	2.6	3.0	2.95	4.2	3.4
26	3.2	3.2	4.2	4.4	4.0	3.4	2.6	2.6	3.0	2.95	4.0	3.4
27	3.0	3.2	4.4	4.8	4.4	3.4	2.7	2.6	3.0	2.95	3.7	3.2
28	3.0	3.4	4.4	4.8	4.6	3.3	2.6	2.6	3.0	2.9	3.6	3.1
29	3.0	.....	4.4	4.8	4.8	3.3	2.7	2.6	3.2	2.9	3.5	3.15
30	3.0	.....	4.6	4.6	4.6	3.3	2.8	2.6	3.1	2.9	3.55	3.0
31	3.0	.....	4.6	.....	4.6	.....	2.8	2.6	.....	2.9	.....	3.0

NOTE.—River frozen Jan. 1 to 19, ice 2 to 10 inches thick. Broke up Jan. 20; river clear Jan. 21. River one-fourth frozen over Jan. 31 to Feb. 7; ice 2 inches thick. Channel clear Feb. 8. Frozen over Nov. 16 to 18; ice 1 inch thick. River clear Nov. 19. Frozen over Dec. 3 to 8, and Dec. 19 to 31. Ice during latter period 2 to 5 inches thick.

Daily discharge, in second-feet, of Grande Ronde River at Hilgard, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	31	85	210	750	910	910	145	26	10	61	61	210
2	31	115	340	750	910	1,080	145	26	26	61	73	210
3	46	115	340	750	910	1,080	115	16	26	61	61	210
4	46	115	340	750	910	910	115	16	61	61	41	210
5	46	115	590	750	910	750	61	16	61	61	61	175
6	46	85	390	750	910	590	61	16	61	85	61	175
7	46	85	340	750	750	520	61	10	61	61	41	210
8	46	85	340	750	750	520	26	10	61	61	41	340
9	46	85	250	590	750	450	61	10	61	61	41	750
10	46	85	210	590	910	450	115	10	85	61	41	340
11	46	85	175	750	910	450	61	10	115	41	41	340
12	46	85	175	750	750	390	61	7	115	41	41	750
13	46	115	175	750	750	450	61	7	61	41	41	450
14	46	145	250	750	750	450	61	7	61	51	41	485
15	46	175	390	750	830	450	61	7	61	51	34	485
16	46	340	590	910	750	450	26	5	61	51	26	450
17	131	340	590	1,080	590	450	26	5	61	51	26	340
18	250	340	590	910	590	340	26	5	61	51	41	210
19	250	340	590	750	520	520	41	5	61	51	61	178
20	670	340	590	750	520	450	41	5	61	51	61	149
21	995	175	590	750	520	390	41	7	61	51	145	149
22	390	115	390	590	520	340	26	7	61	51	145	149
23	340	115	390	590	450	250	26	10	61	51	340	149
24	250	115	390	590	450	175	16	10	61	51	750	149
25	175	115	450	590	450	175	16	10	61	51	590	149
26	115	115	590	750	450	175	10	10	61	51	450	149
27	61	115	750	1,080	750	175	16	10	61	51	295	98
28	61	175	750	1,080	910	145	10	10	61	41	250	72
29	61	.....	750	1,080	1,080	145	16	10	115	41	210	72
30	61	.....	910	910	910	145	26	10	85	41	230	62
31	61	.....	910	.....	910	.....	26	10	.....	41	.....	52

NOTE.—These discharges are based on a rating curve that is not well defined.

Discharges Jan. 1 to 17, reduced 25 per cent and Dec. 19 to 31 reduced 15 per cent from open-water rating, to allow for ice conditions. Other days during the winter months are probably affected to a greater or less extent by ice conditions.

Monthly discharge of Grande Ronde River at Hilgard, Oreg., for 1909.

[Drainage area, 660 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	995	31	148	0.224	0.26	9,100	D.
February	340	85	154	.233	.24	8,550	C.
March	910	175	462	.7	.81	28,400	B.
April	1,080	590	778	1.18	1.32	46,300	B.
May	1,080	450	741	1.12	1.29	45,600	B.
June	1,080	145	459	.695	.78	27,300	B.
July	145	10	51.6	.078	.09	3,170	C.
August	26	5	10.4	.016	.02	640	D.
September	115	10	64.	.097	.11	3,810	C.
October	85	41	52.7	.08	.09	3,240	C.
November	750	26	145	.22	.25	8,630	C.
December	750	52	255	.386	.44	15,700	D.
The year	1,080	5	277	.419	5.70	200,000	

NOTE.—There were no notes regarding log runs during the year.

GRANDE RONDE RIVER AT ELGIN, OREG.

This station, which was established November 20, 1903, is located at the county highway bridge on the road from Elgin to Wallowa, Oreg., at the lower end of Grande Ronde Valley. It is within the city limits of Elgin, above the mouth of Clarks Creek and below the mouth of Indian Creek.

The data collected here have general interest in connection with the study of the run-off of this basin and because of the use of the waters of the stream and tributaries for irrigation in the Grande Ronde Valley.

A chain gage is attached to the upstream side of the bridge. Discharge measurements are made from the downstream side. The gage datum has remained practically unchanged.

The conditions at the station are not favorable for good results. The bed is exceedingly rough, and at high water the current flows at a decided angle to the bridge from which gagings are made.

The following discharge measurement was made by F. F. Henshaw:

October 15, 1909: Width, 51 feet; area, 54.3 square feet; gage height, 1.64 feet; discharge, 74.1 second-feet. Made by wading, 200 feet above bridge.

Daily gage height, in feet, of Grande Ronde River at Elgin, Oreg., for 1909.

[John Graham, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.15	2.65	3.6	3.75	4.4	2.45	1.9	1.45	1.65	1.7	2.6
2	1.9	2.35	2.65	3.65	3.75	4.45	2.35	1.85	1.5	1.65	1.75	2.6
3	2.0	2.25	2.7	3.7	3.75	4.45	2.30	1.75	1.5	1.65	1.75	2.6
4	2.0	2.15	2.9	3.8	3.75	4.55	2.35	1.75	1.5	1.65	1.75	2.5
5	2.0	2.05	3.05	3.65	3.75	4.45	2.25	1.7	1.5	1.65	1.75	2.3
6	2.05	2.0	3.0	3.5	3.8	4.3	2.25	1.65	1.5	1.65	1.8	2.3
7	2.05	2.0	2.9	3.4	3.85	3.95	2.2	1.65	1.5	1.7	1.8	2.65
8	2.1	2.0	2.85	3.3	3.85	3.85	2.15	1.65	1.5	1.7	1.8	2.5
9	2.2	2.0	2.85	3.1	3.95	3.8	2.1	1.65	1.5	1.7	1.85	2.5
10	2.3	1.9	2.8	3.2	3.9	3.65	2.1	1.55	1.55	1.75	1.8	2.5
11	2.55	1.9	2.75	3.4	3.75	3.55	2.1	1.55	1.55	1.7	1.8	2.3
12	2.5	1.9	2.6	3.4	3.75	3.5	2.05	1.55	1.55	1.7	1.8	2.2
13	2.3	2.0	2.65	3.5	3.65	3.45	2.05	1.55	1.55	.....	1.75	2.3
14	2.3	2.05	2.65	3.6	3.55	3.45	2.00	1.55	1.55	1.6	1.75	2.45
15	2.35	2.1	2.7	3.7	3.55	3.4	1.95	1.45	1.55	1.6	1.75	2.3
16	2.5	2.75	2.9	3.8	3.55	3.35	1.85	1.45	1.65	1.6	1.75	2.2
17	2.5	2.75	3.3	3.7	3.55	3.3	1.8	1.55	1.65	1.6	1.7	2.2
18	2.6	3.1	3.5	3.7	3.45	3.25	1.8	1.55	1.65	1.6	1.75	2.15
19	2.7	2.9	3.3	3.65	3.45	3.25	1.75	1.55	1.65	1.6	1.75	2.15
20	2.9	2.8	3.2	3.55	3.45	3.25	1.75	1.55	1.65	1.65	2.05	2.15
21	3.3	2.7	3.1	3.5	3.45	3.25	1.7	1.55	1.65	1.6	2.0	2.15
22	3.3	2.5	3.0	3.5	3.45	3.15	1.65	1.45	1.65	1.6	2.9	2.2
23	2.9	2.4	2.95	3.4	3.45	3.1	1.65	1.5	1.65	1.6	3.3	2.3
24	2.7	2.3	2.95	3.4	3.35	3.05	1.65	1.5	1.65	1.6	3.5	2.2
25	2.45	2.35	3.2	3.6	3.35	2.95	1.65	1.45	1.65	1.6	3.4	2.15
26	2.4	2.4	3.4	3.7	3.35	2.75	1.65	1.45	1.65	1.6	3.0	2.0
27	2.3	2.35	3.6	3.8	3.65	2.65	1.75	1.45	1.65	1.65	2.9	2.1
28	2.0	2.4	3.6	3.9	4.1	2.55	1.85	1.45	1.65	1.7	2.7	2.3
29	2.0	.....	3.65	4.0	4.35	2.5	1.75	1.45	1.65	1.7	2.6	2.2
30	2.0	.....	3.65	3.9	4.35	2.45	1.95	1.45	1.65	1.7	2.6	2.05
31	2.0	.....	3.6	.....	4.35	.....	1.95	1.45	.....	1.7	.....	2.15

NOTE.—Ice conditions Dec. 7 and Dec. 27 to 29. Ice gorging Jan. 6 to 15.

Daily discharge, in second-feet, of Grande Ronde River at Elgin, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	150	240	485	1,340	1,560	2,660	375	150	36	80	92	455
2	150	328	485	1,410	1,560	2,750	328	135	45	80	106	455
3	185	282	515	1,480	1,560	2,750	305	106	45	80	106	455
4	185	240	640	1,630	1,560	2,930	328	106	45	80	106	400
5	185	202	750	1,410	1,560	2,750	282	92	45	80	106	305
6	202	185	710	1,210	1,630	2,480	282	80	45	80	120	305
7	202	185	640	1,090	1,710	1,880	260	80	45	92	120	352
8	220	185	608	980	1,710	1,710	240	80	45	92	120	400
9	237	185	608	790	1,880	1,630	220	80	45	92	135	400
10	254	150	575	880	1,790	1,410	220	56	56	106	120	400
11	271	150	545	1,090	1,560	1,280	220	56	56	92	120	305
12	288	150	455	1,090	1,560	1,210	202	56	56	92	120	260
13	305	185	485	1,210	1,410	1,150	202	56	56	80	106	305
14	305	202	485	1,340	1,280	1,150	185	56	56	67	106	375
15	328	220	515	1,480	1,280	1,090	168	36	56	67	106	305
16	400	545	640	1,630	1,280	1,040	135	36	80	67	106	260
17	400	545	980	1,480	1,280	980	120	56	80	67	92	260
18	455	790	1,210	1,480	1,150	930	120	56	80	67	106	240
19	515	640	980	1,410	1,150	930	106	56	80	67	106	240
20	640	575	880	1,280	1,150	930	106	56	80	80	202	240
21	980	515	790	1,210	1,150	930	92	56	80	67	185	240
22	980	400	710	1,210	1,150	835	80	36	80	67	640	260
23	640	350	675	1,090	1,150	790	80	45	80	67	980	305
24	515	305	675	1,090	1,040	750	80	45	80	67	1,210	260
25	375	328	880	1,340	1,040	675	80	36	80	67	1,090	240
26	350	350	1,090	1,480	1,040	545	80	36	80	67	710	185
27	305	328	1,340	1,630	1,410	485	106	36	80	80	640	189
28	185	350	1,340	1,790	2,130	428	135	36	80	92	515	194
29	185	.....	1,410	1,960	2,570	400	106	36	80	92	455	198
30	185	.....	1,410	1,790	2,570	375	168	36	80	92	455	202
31	185	.....	1,340	.....	2,570	.....	168	36	.....	92	.....	240

NOTE.—These discharges are based on a rating curve that is fairly well defined below 3,700 second-feet. Discharges for Jan. 9 to 12, Dec. 7 and Dec. 27 to 29 interpolated to allow for ice conditions.

Monthly discharge of Grande Ronde River at Elgin, Oreg., for 1909.

[Drainage area, 1,350 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	980	150	347	0.257	0.30	21,300	C.
February	790	150	325	.241	.25	18,000	B.
March	1,410	455	802	.594	.68	49,300	B.
April	1,960	790	1,340	.993	1.11	79,700	B.
May	2,570	1,040	1,530	1.13	1.30	94,100	B.
June	2,930	375	1,330	.985	1.10	79,100	B.
July	375	80	180	.133	.15	11,100	B.
August	150	36	61.9	.046	.05	3,810	B.
September	80	36	64.4	.048	.05	3,830	B.
October	106	67	79.3	.059	.07	4,880	B.
November	1,210	92	306	.227	.25	18,200	B.
December	455	185	298	.221	.25	18,300	C.
The year	2,930	36	555	.411	5.56	402,000	

GRANDE RONDE RIVER AT ZINDEL, WASH.

This station was established June 30, 1904. It is located at Zindel Ferry, 2 miles above the mouth of the stream, 1½ miles below Joseph Creek. The records show the quantity of water contributed to Snake River by the Grande Ronde drainage basin.

The data obtained are of scientific interest in connection with a general study of run-off factors from such forested areas as are found in the Blue Mountains, and are also of value in determining the value of the water powers of the lower Grande Ronde.

An inclined gage is located on the left bank just below the ferry. Discharge measurements are made from the ferryboat.

The datum of the gage has not been changed since it was installed. The gage-height records are complete, but, owing to the inaccessibility of the station, few measurements have been made. The conditions at the station are favorable for the construction of a permanent rating curve.

No measurements were made in 1909.

Daily gage height, in feet, of Grande Ronde River at Zindel, Wash., for 1909.

[M. W. Zindel, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.7	3.1	4.9	4.8	6.0	4.2	3.0	2.1	2.1	2.4	4.0
2	2.4	2.7	3.3	4.9	5.0	6.5	4.4	3.0	2.2	2.1	2.4	3.9
3	2.4	2.6	3.5	4.8	5.3	6.3	4.4	3.0	2.2	2.1	2.6	3.9
4	2.4	2.8	4.0	4.8	5.8	6.1	4.0	2.8	2.2	2.1	2.6	3.9
5	2.1	2.8	4.0	4.6	5.4	6.0	4.0	2.8	2.2	2.1	2.8	3.7
6	2.0	2.8	3.9	4.5	5.2	6.0	3.9	2.7	2.2	2.0	2.8	3.5
7	2.0	2.8	3.9	4.2	5.2	5.8	3.6	2.6	2.2	2.0	2.8	3.0
8	2.0	2.7	3.9	4.0	5.1	5.5	3.5	2.6	2.1	2.0	2.7	3.0
9	2.0	2.7	3.7	4.0	5.1	5.5	3.4	2.5	2.1	2.0	2.7	2.8
10	2.0	2.7	3.6	4.1	5.0	5.0	3.4	2.5	2.1	2.0	2.6	2.8
11	1.5	2.6	3.5	4.3	5.0	5.0	3.6	2.4	2.1	2.0	2.6	2.7
12	1.5	2.6	3.5	4.5	5.0	4.8	3.4	2.4	2.1	2.0	2.5	2.5
13	1.5	2.6	3.4	4.7	4.8	4.9	3.4	2.3	2.1	2.1	2.5	2.5
14	1.5	2.8	3.4	4.8	4.7	5.0	3.4	2.3	2.1	2.1	2.5	2.5
15	2.0	3.7	3.5	4.8	4.7	5.0	3.3	2.3	2.2	2.1	2.5	2.5
16	2.0	4.2	3.7	4.9	4.7	5.0	3.3	2.3	2.2	2.1	2.5	2.5
17	4.0	4.0	3.8	4.8	4.6	5.2	3.2	2.3	2.2	2.2	2.5	2.3
18	3.6	3.8	3.9	4.7	4.6	5.4	3.1	2.3	2.25	2.2	2.5	2.3
19	3.8	3.8	3.9	4.6	4.6	5.5	3.0	2.3	2.25	2.3	3.0	2.2
20	4.0	3.7	4.0	4.6	4.5	5.5	3.0	2.2	2.2	2.3	3.5	2.1
21	4.6	3.7	4.0	4.6	4.5	5.3	3.0	2.2	2.2	2.3	3.6	2.1
22	4.6	3.5	4.0	4.5	4.4	5.0	3.0	2.2	2.1	2.3	3.4	2.1
23	4.0	3.3	4.5	4.5	4.3	4.7	3.1	2.2	2.1	2.3	3.4	2.0
24	3.5	3.3	4.8	4.5	4.3	4.7	3.1	2.2	2.1	2.4	3.8	2.0
25	3.0	3.2	4.9	4.5	4.2	4.7	3.4	2.1	2.1	2.4	4.0	2.0
26	3.0	3.2	5.0	4.7	4.2	4.5	3.4	2.1	2.0	2.4	5.2	2.0
27	2.8	3.1	5.0	4.9	4.2	4.4	4.0	2.1	2.0	2.4	6.0	2.0
28	2.8	3.1	4.9	5.0	4.4	4.4	4.0	2.1	2.0	2.4	5.3	2.0
29	2.8	.....	4.9	5.0	4.5	4.2	3.9	2.1	2.0	2.4	5.0	2.0
30	2.8	.....	4.9	5.2	4.8	4.2	3.6	2.1	2.1	2.4	4.3	2.0
31	2.8	.....	4.9	.....	5.1	.....	3.0	2.1	.....	2.4	.....	2.0

NOTE.—Ice conditions Jan. 9 to 16.

WALLOWA RIVER NEAR JOSEPH, OREG.

This station, which was established November 12, 1903, is located about 300 feet below the controlling dam at the outlet of Wallowa Lake and about 1½ miles above Joseph, Oreg.

The data are of value in connection with irrigation development and have scientific interest in connection with the determination of run-off from the forested areas of the Powder River Mountains.

Four large irrigation ditches divert a large portion of the normal flow of the river below the gage, the headgate for the first diversion being about 125 feet below the gage. The timber dam at the outlet of Wallowa Lake is jointly owned and operated by the managers of the irrigation ditches.

The original staff gage was located on Wallowa Lake near its outlet, but when the timber regulating dam was constructed it was moved July 12, 1905, to a point on the right bank of the river 500 feet downstream and 50 feet above a footbridge, from which the discharge measurements are made. From March 31 to July 12, 1905, readings were taken on a temporary gage about 100 feet below the dam and reduced to the datum of the new staff gage set July 12, 1905. The gage heights are subject to regulation by the dam above.

The bed of the river is composed of coarse gravel and bowlders and is very rough. Individual discharge measurements can not be made with great accuracy, except by taking unusual precautions, but a rating curve averaging all the measurements gives fair results.

The following discharge measurement was made by F. F. Henshaw:

October 17, 1909: Width, 27 feet; area, 36.4 square feet; gage height, 2.13 feet; discharge, 88.6 second-feet. This measurement was made by wading.

Daily gage height, in feet, of Wallowa River near Joseph, Oreg., for 1909.

[John Martin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.9	2.0	1.8	2.1	2.0	2.9	3.3	2.9	2.6	2.15	2.1	2.2
2	1.9	2.0	1.8	2.1	2.0	2.9	3.3	2.9	2.6	2.15	2.1	2.2
3	1.9	2.0	1.8	2.1	2.0	2.9	3.3	3.0	2.6	2.15	2.1	2.2
4	1.9	2.0	1.8	2.1	2.0	2.9	3.2	3.0	2.6	2.15	2.1	2.2
5	1.9	2.0	1.8	2.1	2.0	3.1	3.2	3.0	2.5	2.15	2.1	2.2
6	1.9	2.0	1.8	2.1	2.0	3.2	3.2	3.0	2.5	2.15	2.1	2.2
7	1.9	2.0	1.8	2.1	2.0	3.2	3.2	3.0	2.5	2.15	2.1	2.2
8	1.9	2.0	1.8	2.1	2.0	3.2	3.2	3.0	2.5	2.15	2.1	2.2
9	1.9	2.0	1.8	2.1	2.0	3.2	3.2	3.0	2.5	2.15	2.1	2.2
10	1.9	2.0	1.8	2.1	2.0	3.2	3.2	3.0	2.5	2.15	2.1	2.2
11	1.9	2.0	1.8	2.0	2.0	3.2	3.0	3.0	2.5	2.15	2.1	2.2
12	1.9	2.0	1.8	2.0	2.0	3.2	3.0	3.0	2.4	2.15	2.1	2.2
13	1.9	2.0	1.8	2.0	2.0	3.2	3.0	3.0	2.4	2.15	2.1	2.2
14	1.9	1.9	1.8	2.0	2.0	3.2	2.8	3.0	2.4	2.15	2.1	2.2
15	1.9	1.9	1.8	2.0	2.0	3.2	2.8	3.0	2.4	2.15	2.1	2.2
16	1.9	1.9	1.8	2.0	2.0	3.2	2.8	3.0	2.3	2.15	2.1	2.2
17	1.9	1.8	1.9	2.0	2.0	3.3	2.8	2.9	2.3	2.15	2.1	2.2
18	1.9	1.8	1.9	2.0	2.0	3.3	2.8	2.9	2.3	2.15	2.1	2.2
19	1.9	1.8	1.9	2.0	2.0	3.3	2.8	2.8	2.15	2.15	2.1	2.2
20	1.9	1.8	1.9	2.0	2.0	3.3	2.8	2.8	2.15	2.15	2.1	2.2
21	1.9	1.8	2.0	2.0	2.4	3.3	2.8	2.8	2.15	2.15	2.2	2.2
22	1.9	1.8	2.0	2.0	2.4	3.3	2.8	2.8	2.15	2.15	2.2	2.2
23	1.9	1.8	2.0	2.0	2.4	3.3	2.8	2.8	2.15	2.15	2.2	2.2
24	2.0	1.8	2.0	2.0	2.4	3.3	2.8	2.7	2.15	2.1	2.2	2.2
25	2.0	1.8	2.0	2.0	2.4	3.2	2.8	2.7	2.15	2.1	2.2	2.2
26	2.0	1.8	2.0	2.0	2.7	3.2	2.8	2.7	2.15	2.1	2.2	2.2
27	2.0	1.8	2.0	2.0	2.7	3.2	2.9	2.6	2.15	2.1	2.2	2.2
28	2.0	1.8	2.0	2.0	2.7	3.2	2.9	2.6	2.15	2.1	2.2	2.2
29	2.0	.....	2.0	2.0	2.7	3.2	2.9	2.6	2.15	2.1	2.2	2.2
30	2.0	.....	2.0	2.0	2.7	3.2	2.9	2.6	2.15	2.1	2.2	2.2
31	2.0	.....	2.0	.....	2.7	.....	2.9	2.6	.....	2.1	.....	2.2

Daily discharge, in second-feet, of Wallowa River near Joseph, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	41	60	26	80	60	375	630	375	240	92	80	105
2	41	60	26	80	60	375	630	375	240	92	80	105
3	41	60	26	80	60	375	630	435	240	92	80	105
4	41	60	26	80	60	375	560	435	240	92	80	105
5	41	60	26	80	60	495	560	435	200	92	80	105
6	41	60	26	80	60	560	560	435	200	92	80	105
7	41	60	26	80	60	560	560	435	200	92	80	105
8	41	60	26	80	60	560	560	435	200	92	80	105
9	41	60	26	80	60	560	560	435	200	92	80	105
10	41	60	26	80	60	560	560	435	200	92	80	105
11	41	60	26	60	60	560	435	435	200	92	80	105
12	41	60	26	60	60	560	435	435	165	92	80	105
13	41	60	26	60	60	560	435	435	165	92	80	105
14	41	41	26	60	60	560	325	435	165	92	80	105
15	41	41	26	60	60	560	325	435	165	92	80	105
16	41	41	26	60	60	560	325	435	135	92	80	105
17	41	26	41	60	60	630	325	375	135	92	80	105
18	41	26	41	60	60	630	325	375	135	92	80	105
19	41	26	41	60	60	630	325	325	92	92	80	105
20	41	26	41	60	60	630	325	325	92	92	80	105
21	41	26	60	60	165	630	325	325	92	92	105	105
22	41	26	60	60	165	630	325	325	92	92	105	105
23	41	26	60	60	165	630	325	325	92	92	105	105
24	60	26	60	60	165	630	325	280	92	80	105	105
25	60	26	60	60	165	560	325	280	92	80	105	105
26	60	26	60	60	280	560	325	280	92	80	105	105
27	60	26	60	60	280	560	375	240	92	80	105	105
28	60	26	60	60	280	560	375	240	92	80	105	105
29	60	.....	60	60	280	560	375	240	92	80	105	105
30	60	.....	60	60	280	560	375	240	92	80	105	105
31	60	.....	60	.....	280	.....	375	240	.....	80	.....	105

NOTE.—These discharges are based on a rating curve that is fairly well defined between 60 and 430 second-feet.

Monthly discharge of Wallowa River near Joseph, Oreg., for 1909.

[Drainage area, 47 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	60	41	45.9	0.977	1.13	2,820	C.
February	60	26	43.4	.923	.96	2,410	C.
March	60	26	40.0	.851	.98	2,460	C.
April	80	60	66.7	1.42	1.58	3,970	C.
May	280	60	120	2.55	2.94	7,380	C.
June	630	375	552	11.7	13.05	32,800	B.
July	630	325	426	9.06	10.44	26,200	B.
August	435	240	363	7.72	8.90	22,300	B.
September	240	92	151	3.21	3.58	8,980	B.
October	92	80	88.9	1.89	2.18	5,470	C.
November	105	80	88.3	1.88	2.10	5,250	C.
December	105	105	10.5	2.23	2.57	6,460	C.
The year	630	26	17.4	3.70	50.41	126,000	

WALLOWA RIVER NEAR ELGIN, OREG.

This station, which was established November 18, 1903, is located in Wallowa Canyon, at Minam post office, about 9 miles below the lower end of Wallowa Valley, just below the mouth of Minam River

and 12 miles from Elgin, Oreg. It is near Minam station on the extension of the Elgin branch of the Oregon Railroad & Navigation Co.'s line.

The data are of interest in connection with the determination of run-off factors for areas similar to the Wallowa drainage and will be valuable for water-power developments.

The gage is in two sections on the left bank at the site of the old bridge which collapsed during October, 1905. Discharge measurements were formerly made here, but from this date until August, 1906, they were made from a temporary bridge 900 feet upstream. The new steel highway bridge, from which measurements are now made, is about 1,000 feet upstream from the gage. The location and datum of the gage have remained unchanged.

During the winter months ice affects the results to a considerable degree. Occasionally ice gorges form below the station which back the water above the gage. The flow of the stream is fairly uniform.

The following discharge measurement was made by F. F. Henshaw:

October 16, 1909: Width, 130 feet; area, 230 square feet; gage height, 2.55 feet; discharge, 433 second-feet.

Daily gage height, in feet, of Wallowa River near Elgin, Oreg., for 1909.

[A. M. Bowell, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.4	2.9	2.9	3.3	3.4	4.9	4.7	3.2	2.5	2.7	2.55	3.2
2	2.4	2.8	3.0	3.3	3.5	5.6	4.5	3.2	2.5	2.6	2.55	3.15
3	2.5	2.7	3.0	3.3	3.9	5.8	4.6	3.2	2.5	2.6	2.7	3.1
4	2.7	2.7	3.1	3.2	4.3	5.7	4.6	3.1	2.6	2.6	2.8	2.9
5	2.6	2.7	3.0	3.2	4.2	5.6	4.6	3.1	2.6	2.6	2.8	2.9
6	2.5	2.7	3.1	3.1	4.0	5.5	4.2	3.0	2.6	2.6	2.8	2.9
7	2.6	2.7	2.9	3.0	4.0	5.1	4.0	2.9	2.6	2.8	2.7	2.85
8	2.6	2.7	2.9	3.0	3.9	4.9	3.8	2.9	2.6	2.7	2.75	2.9
9	2.6	2.7	2.9	3.1	4.0	4.5	3.9	2.8	2.6	2.7	2.75	2.9
10	5.1	2.7	2.9	3.2	4.0	4.5	3.9	2.8	2.7	2.7	2.75	2.9
11	4.5	2.7	2.9	3.1	3.8	4.4	4.0	2.8	2.7	2.6	2.8	2.9
12	3.2	2.6	2.8	3.1	3.7	4.4	3.9	2.7	2.7	2.6	2.75	2.85
13	3.2	2.8	2.8	3.2	3.5	5.1	3.8	2.7	2.6	2.6	2.7	2.75
14	3.1	2.7	3.0	3.1	3.5	5.2	3.7	2.7	2.6	2.6	2.7	2.7
15	3.2	2.6	3.0	3.2	3.6	5.2	3.7	2.7	2.7	2.6	2.7	2.9
16	3.6	2.6	3.1	3.3	3.7	5.2	3.6	2.7	2.7	2.6	2.6	2.8
17	3.6	3.5	3.3	3.4	3.7	5.2	3.6	2.7	2.7	2.5	2.7	3.0
18	3.2	3.1	3.1	3.3	3.6	5.0	3.5	2.7	2.6	2.5	2.8	3.0
19	3.3	3.0	3.1	3.4	3.6	5.0	3.4	2.6	2.5	2.5	3.0	2.8
20	3.9	2.8	3.1	3.4	3.9	5.2	3.3	2.6	2.5	2.5	3.25	2.8
21	3.6	2.7	3.0	3.3	4.0	5.0	3.3	2.6	2.6	2.5	3.0	2.8
22	3.6	2.6	3.0	3.3	3.8	4.7	3.2	2.6	2.6	2.5	3.3	2.9
23	3.3	2.6	2.9	3.4	3.7	4.7	3.2	2.6	2.6	2.5	4.0	6.75
24	3.1	2.7	3.1	3.3	3.6	4.5	3.2	2.6	2.5	2.5	4.4	2.8
25	3.1	2.7	3.2	3.4	3.8	4.5	3.0	2.6	2.5	2.5	3.9	2.85
26	2.8	2.7	3.2	3.6	4.3	4.4	3.0	2.5	2.5	2.5	3.5	2.8
27	2.8	2.7	3.3	3.7	4.5	4.3	3.2	2.5	2.5	2.5	3.45	2.9
28	2.8	2.8	3.3	3.7	4.8	4.4	4.0	2.5	2.5	2.5	3.3	2.8
29	2.8	.....	3.3	3.5	4.5	4.5	3.5	2.5	2.5	2.5	3.2	2.7
30	2.9	.....	3.2	3.5	4.4	4.7	3.3	2.5	2.7	2.5	3.2	2.7
31	2.9	.....	3.2	.....	4.4	.....	3.3	2.5	.....	2.5	.....	3.0

NOTE.—River full of running ice Jan. 10. Water backed up on gage Dec. 23 and 31.

Daily discharge, in second-feet, of Wallowa River near Elgin, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	405	780	780	1,200	1,330	3,920	3,500	1,080	470	615	505	1,080
2	405	695	870	1,200	1,470	5,650	3,100	1,080	470	540	505	1,020
3	470	615	870	1,200	2,060	6,260	3,300	1,080	470	540	615	970
4	615	615	970	1,080	2,730	5,950	3,300	970	540	540	695	780
5	540	615	870	1,080	2,560	5,650	3,300	970	540	540	695	780
6	470	615	970	970	2,220	5,360	2,560	870	540	540	695	780
7	540	615	780	870	2,220	4,370	2 220	780	540	695	615	738
8	540	615	780	870	2,060	3,920	,900	780	540	615	655	780
9	540	615	780	970	2,220	3,100	2,060	695	540	615	655	780
10	4,370	615	780	1,080	2,220	3,100	2,060	695	615	615	655	780
11	3,100	615	780	970	1,900	2,910	2,220	695	615	540	695	780
12	1,080	540	695	970	1,760	2,910	2,060	615	615	540	655	738
13	1,080	695	695	1,080	1,470	4,370	1,900	615	540	540	615	655
14	970	615	870	970	1,470	4,600	1,760	615	540	540	615	615
15	1,080	540	870	1,080	1,610	4,600	1,760	615	615	540	615	780
16	1,610	540	970	1,200	1,760	4,600	1,610	615	615	540	540	695
17	1,610	1,470	1,200	1,330	1,760	4,600	1,610	615	615	470	615	870
18	1,080	970	970	1,200	1,610	4,140	1,470	615	540	470	695	870
19	1,200	870	970	1,330	1,610	4,140	1,330	540	470	470	870	695
20	2,060	695	970	1,330	2,060	4,600	1,200	540	470	470	1,140	695
21	1,610	615	870	1,200	2,220	4,140	1,200	540	540	470	870	695
22	1,610	540	870	1,200	1,900	3,500	1,080	540	540	470	1,200	780
23	1,200	540	780	1,330	1,760	3,500	1,080	540	540	470	2,220	742
24	970	615	970	1,200	1,610	3,100	1,080	540	470	470	2,910	695
25	970	615	1,080	1,330	1,900	3,100	870	540	470	470	2,060	738
26	695	615	1,080	1,610	2,730	2,910	870	470	470	470	1,470	695
27	695	615	1,200	1,760	3,100	2,730	1,080	470	470	470	1,400	780
28	695	695	1,200	1,760	3,700	2,910	2,220	470	470	470	1,200	695
29	695	.....	1,200	1,470	3,100	3,100	1,470	470	470	470	1,080	615
30	780	.....	1,080	1,470	2,910	3,500	1,200	470	615	470	1,080	615
31	780	.....	1,080	.....	2,910	.....	1,200	470	.....	470	.....	615

NOTE.—These discharges are based on a rating curve that is not well defined. Discharges for Dec. 23 and 31 estimated, due to ice conditions.

Monthly discharge of Wallowa River near Elgin, Oreg., for 1909.

[Drainage area, 870 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	4,370	405	1,110	1.28	1.48	68,200	B.
February	1,470	540	671	.771	.80	37,300	B.
March	1,200	695	931	1.07	1.23	57,200	B.
April	1,760	870	1,210	1.39	1.55	72,000	B.
May	3,700	1,330	2,130	2.45	2.82	131,000	B.
June	6,260	2,730	4,040	4.64	5.18	240,000	B.
July	3,500	870	1,860	2.14	2.47	114,000	B.
August	1,080	470	665	.764	.88	40,900	B.
September	615	470	532	.611	.68	31,700	B.
October	695	470	521	.599	.69	32,000	B.
November	2,910	505	961	1.10	1.23	57,200	B.
December	1,080	615	760	.874	1.01	46,700	B.
The year	6,260	405	1,280	1.47	20.02	928,000	

PALOUSE RIVER DRAINAGE BASIN.

DESCRIPTION.

Palouse River rises in the northern part of Latah County, Idaho, on the divide between the Spokane and Snake River drainage basins, flows west and then south, and discharges into Snake River in the southwest corner of Whitman County, Wash. The drainage area comprises 2,310 square miles, and at Winona measures 1,120 square miles.

The surface is in general rolling and in some places is rough and broken. The average elevation at the headwaters of the stream is 3,000 feet above sea level; the elevation at Colfax is 1,974 feet.

The principal tributary of Palouse River is Rock Creek, which drains a number of small lakes in the northern part of Whitman County, Wash. The agricultural lands consist chiefly of rolling table-lands, which are largely utilized for the production of wheat. No forests of magnitude are found on the drainage area, and such as do exist are of the small black pines near the headwaters of the stream.

The mean annual rainfall is about 20 inches, much of which falls during the winter months in the form of snow.

The region is well adapted to irrigation, though the present development in that direction is restricted to the small areas contiguous to the streams where irrigation by individual or small company ditches is possible. A number of projects have been contemplated, involving the storage of waters from the main stream and its tributaries in some of the storage sites which are found in this area. These sites are in the form of long canyons, called coulees, usually dry. Dams constructed at favorable points in such coulees will develop storage reservoirs of considerable capacity, but unfortunately the water must be supplied by artificial channels, as the drainage area above them is usually insufficient to insure an adequate water supply. The soil of the country is well adapted to all kinds of products possible through irrigated agriculture.

PALOUSE RIVER AT HOOPER, WASH.

This station, which was originally established April 1, 1897, by the land department of the Northern Pacific Railway, was taken over by the United States Geological Survey September 9, 1897, and reestablished about 1 mile downstream and above the mouth of Cow Creek. It is 1 mile from Hooper, Wash., a station on the Oregon Railroad & Navigation Co.'s line.

The data obtained at this point are of value as indicating the amount of water available for irrigation on the lands of the Washtucna Valley and the territory to the north of Pasco. As the low-water flow is comparatively small, any development for irrigation must

involve the construction of storage reservoirs. A number of sites were under consideration when the Palouse project was investigated by the United States Reclamation Service.

Several gages have been used, all referred to the same datum. The present gage is in two sections; an inclined low-water staff and a vertical staff on the right bank at the cable from which discharge measurements are made. The gage datum has remained unchanged. It is 1,053.42 feet above sea level.

The conditions at the station are favorable for good results. During the winter months there is little or no interference from ice, so that continuous records have been possible when gage observers were available.

The following discharge measurement was made by G. L. Parker:

October 20, 1909: Width, 60 feet; area, 68 square feet; gage height, 1.01 feet; discharge, 26 second-feet.

Daily gage height, in feet, of Palouse River at Hooper, Wash., for 1909.

[Mrs. L. C. Huffman, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.90	3.65	6.10	4.25	3.75	2.20	1.22	0.98	0.75	0.92	1.05	2.30
2	1.65	3.60	6.20	4.37	3.40	2.18	1.28	.95	.75	.96	1.22	2.80
3	1.65	3.90	5.50	4.70	3.90	2.08	1.22	.97	.75	.94	1.20	3.80
4	1.60	3.90	5.50	4.60	3.70	2.25	1.22	1.05	.75	.92	1.32	2.90
5	1.22	3.82	5.00	4.20	3.60	2.20	1.20	1.07	.73	.90	1.32	2.80
6	1.20	3.68	5.00	3.82	3.30	2.18	2.12	1.00	.70	.96	1.36	2.18
7	1.50	3.53	5.10	3.70	3.30	2.10	1.00	.98	.70	.94	2.42	2.12
8	1.20	3.48	4.70	3.50	3.00	2.18	1.30	.97	.69	.92	2.04	1.98
9	1.18	3.50	4.72	3.50	3.20	1.20	1.25	.85	.69	.90	1.90	2.35
10	1.18	3.25	4.70	3.22	2.85	1.50	1.20	.84	.75	.95	1.85	2.40
11	1.20	3.12	4.70	3.10	2.60	1.90	1.20	.86	.68	.94	2.00	2.95
12	1.22	3.05	4.27	3.50	2.40	2.03	1.32	.95	.70	.94	1.85	2.90
13	1.22	3.00	4.10	3.50	2.45	2.00	1.28	.98	.71	.95	1.70	3.30
14	1.25	3.00	4.00	3.75	2.75	1.20	1.25	1.05	.70	.93	1.80	5.00
15	1.25	2.98	4.10	3.35	2.40	1.50	1.20	.95	.70	.96	1.76	4.90
16	1.28	3.55	4.10	3.50	2.45	1.85	1.15	.97	.69	.95	1.92	4.05
17	1.35	8.30	4.80	3.50	3.50	1.88	1.20	1.00	.70	.93	1.80	3.60
18	10.78	8.10	4.50	3.75	2.30	1.50	1.10	.88	.69	.95	1.80	3.25
19	14.00	8.00	4.00	3.50	2.20	1.53	1.02	.90	.70	1.02	1.65	3.10
20	15.75	7.20	4.00	2.95	2.60	1.70	1.00	.83	.71	1.10	1.55	2.60
21	14.50	6.50	4.10	3.30	2.30	1.71	1.00	.79	.73	1.20	1.53	2.50
22	11.00	5.60	4.00	3.30	2.32	1.68	.98	.76	.73	1.13	2.10	2.15
23	9.50	5.00	3.70	3.10	2.30	1.70	.98	.80	.75	1.10	3.15	2.10
24	7.10	4.80	3.75	3.00	2.20	1.50	.97	.76	.80	1.13	3.25	2.15
25	6.00	4.60	3.85	2.70	2.20	1.45	.94	.76	.80	1.23	3.65	2.05
26	5.60	4.75	3.80	3.22	2.10	1.20	.94	.77	.81	1.13	3.30	1.98
27	4.95	4.45	3.70	2.95	2.33	1.28	.93	.77	.80	1.13	3.20	2.10
28	4.42	4.50	3.75	3.15	2.32	1.28	.91	.77	.80	1.05	3.10	2.10
29	3.95	.....	3.75	3.30	2.80	1.28	.92	.76	.85	1.12	2.15	2.10
30	3.75	.....	3.75	4.20	2.60	1.25	1.20	.76	1.50	1.12	2.15	2.15
31	3.80	.....	3.50	.....	2.40	.....	1.08	.75	.....	1.07	.....	2.55

NOTE.—Ice conditions Jan. 5 to 17. River frozen entirely Jan. 9.

Daily discharge, in second-feet, of Palouse River at Hooper, Wash., for 1909.

Day.	Jan	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	174	569	2,040	827	608	195	48	27	15	23	32	215
2	127	551	2,120	885	486	191	55	25	15	26	48	331
3	127	670	1,610	1,080	670	172	48	26	15	24	46	628
4	118	670	1,610	1,020	588	205	48	32	15	23	59	355
5	64	636	1,200	805	551	195	46	34	14	22	59	331
6	62	581	1,260	636	457	191	180	28	13	26	64	191
7	102	527	1,330	588	457	176	28	27	13	24	241	180
8	62	511	1,080	517	380	191	57	26	13	23	165	155
9	60	457	1,090	435	430	46	51	19	13	22	141	225
10	60	443	1,080	405	343	82	46	19	15	25	133	236
11	62	410	1,080	517	283	141	46	20	12	24	158	367
12	64	392	836	517	236	163	59	25	13	24	133	355
13	64	380	760	608	247	158	55	27	13	25	110	457
14	68	380	715	471	319	46	51	32	13	24	125	1,260
15	68	375	760	517	236	57	46	25	13	26	119	1,200
16	72	534	760	517	247	133	41	26	13	25	144	737
17	81	4,110	1,140	608	517	138	46	28	13	24	125	551
18	7,780	3,890	955	517	215	82	36	21	13	25	125	443
19	13,700	3,780	715	367	195	86	30	22	13	30	103	405
20	17,200	2,980	715	457	283	110	28	18	13	36	89	283
21	14,400	2,360	760	457	215	112	28	17	14	46	86	259
22	7,800	1,680	715	405	219	107	27	15	14	39	176	185
23	5,520	1,260	588	380	215	110	27	17	15	36	417	176
24	2,890	1,140	608	307	195	82	26	15	17	39	443	185
25	1,960	1,020	649	435	195	75	24	15	17	49	569	167
26	1,680	1,100	628	367	176	46	24	16	18	39	457	155
27	1,230	927	588	417	221	55	24	16	17	39	430	176
28	911	955	608	457	219	55	23	16	17	32	405	176
29	692	.....	608	805	331	55	23	15	19	38	185	176
30	608	.....	608	706	283	51	46	15	82	38	185	185
31	628	.....	517	.....	236	.....	34	15	.....	34	.....	271

NOTE.—These discharges are based on a curve that is fairly well defined. Discharges from Jan. 5 to 17 estimated, to allow for ice conditions.

Monthly discharge of Palouse River at Hooper, Wash., for 1909.

[Drainage area, 2,210 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	17,200	60	2,530	1.14	1.31	156,000	C.
February	4,110	375	1,190	.538	.56	66,100	B.
March	2,120	517	961	.435	.50	59,100	B.
April	1,080	307	568	.257	.29	33,800	B.
May	670	176	331	.150	.17	20,400	B.
June	205	46	117	.053	.06	6,960	B.
July	180	23	43.6	.020	.02	2,680	B.
August	34	15	21.9	.0099	.01	1,350	B.
September	82	12	16.7	.0076	.008	994	B.
October	49	22	30.0	.014	.02	1,840	B.
November	569	32	186	.084	.09	11,100	B.
December	1,260	155	355	.161	.19	21,800	B.
The year	17,200	12	529	.239	3.23	382,000	

WALLA WALLA RIVER DRAINAGE BASIN.

DESCRIPTION.

Walla Walla River rises on the western slope of the Blue Mountains in the southwest portion of Walla Walla County, Wash., and the northeastern part of Umatilla County, Oreg., and flows westward into Columbia River. Its drainage area lies immediately north of that of Umatilla River and is in many respects similar.

Altitudes within the basin range from 5,000 feet on the headwaters to 1,000 feet near Walla Walla, and the mean annual rainfall ranges from 30 inches in the upper portion to 12 in the lower portion of the area. Only the upper part of the drainage area is forested; the lower half is given to the production of wheat without irrigation, but the lands contiguous to the streams are extensively irrigated.

Climate and soil combine to make the country wonderfully productive, and the agricultural products range from the hardier forage crops to fancy fruits.

The headwaters of the stream afford many water-power and storage sites which, if developed, would more than double the value of this stream. Many times the low-water flow of the river is appropriated for irrigation, and the only solution to a situation that has been aggravated in the extreme and promises to become even more critical as additional areas are irrigated lies in the construction of storage reservoirs.

The conditions for obtaining reliable records of stream flow are not good. The river throughout is swift, and the bed is composed of gravel that changes with every freshet, thus making a permanent rating impossible. On this account the records are incomplete and usually cover the period between floods. Floods on this stream are caused suddenly by chinook winds that melt the snows on the headwaters. Some of these floods have been exceedingly harmful, rendering large areas of fine farm lands worthless and causing great damage to life and property.

WALLA WALLA RIVER NEAR MILTON, OREG.

The records for this station begin February 14, 1903, but they are not continuous. The station has been located at various points from the town of Milton to the Jewel West Bridge, 3 miles above, where a station was established August 16, 1906. Owing to lack of observers, however, the records are not continuous even at this point. A small ditch diverts water from the river just above the station.

The stream bed is composed of coarse gravel, and as the river is subject to violent floods a permanent rating curve has not been constructed; instead it has been practicable to obtain results only

between floods. A number of gages and equipments for gaging have been washed away during these excessive floods, and at such a time the aspect of the river undergoes a great change.

As a result of a flood which occurred May 30, 1906, new channels were formed in many places.

No discharge measurements were made during 1909. The gage was read up to July 5, 1909, but as the records are entirely unreliable the data are withheld from publication.

SOUTH FORK OF WALLA WALLA RIVER NEAR MILTON, OREG.

This station was originally established February 15, 1903, 1 mile above the mouth of the river and 7 miles from Milton, Oreg.

The flood of May 30, 1906, changed the channel of the river and left the gage high and dry. On August 10 a new station was established one-fourth mile above the head gate of the Northwest Gas & Electric Co.'s pipe line, in the canyon, 12 miles from Milton. It is above all diversions for irrigation.

The data obtained at this station are of considerable value in connection with both water power and irrigation, and they also furnish some interesting information concerning the run-off from small forested drainage areas under the climatic conditions that obtain in the Blue Mountains. The stream is fed by springs and the flow is well maintained, although subject to violent floods.

The conditions at this station are not permanent, and a new rating curve will be required after each large flood. Since the station was established one gage has been washed away and the records interrupted from March 14, 1908, to October 14, 1908, when a new gage was installed at the same point and datum as the old. Individual measurements can be made with accuracy at low stages. For low-water conditions the records obtained prior to August 10, 1906, are not comparable with those obtained afterwards, because the water is largely diverted for irrigation in small ditches before reaching the lower station. A considerable portion of this water is undoubtedly returned to the stream, and there are also some contributions from intermediate drainage.

No discharge measurements were made during 1909. Daily and monthly estimates of discharge are withheld until more data have been obtained.

Daily gage height, in feet, of South Fork of Walla Walla River near Milton, Oreg., for 1909.

[John Munson, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.7	2.8	2.9	3.1	3.35	3.3	2.8	2.7	2.7	2.7	2.7	3.0
2	2.7	2.8	2.9	3.1	3.55	3.3	2.8	2.7	2.7	2.7	2.7	3.0
3	2.7	2.8	3.0	3.1	3.4	3.3	2.8	2.7	2.7	2.7	2.85	2.9
4	2.7	2.8	3.1	3.1	3.4	3.3	2.8	2.7	2.7	2.7	3.0	2.9
5	2.7	2.8	3.1	3.1	3.4	3.2	2.8	2.7	2.7	2.7	2.85	2.9
6	2.7	2.8	3.0	3.1	3.4	3.2	2.8	2.7	2.7	2.7	2.8	2.9
7	2.7	2.8	3.0	3.1	3.4	3.2	2.8	2.7	2.7	2.7	2.8	2.9
8	2.7	2.8	3.0	3.1	3.3	3.2	2.8	2.7	2.7	2.7	2.8	2.9
9	2.7	2.8	3.0	3.1	3.3	3.2	2.8	2.7	2.7	2.7	2.8	2.9
10	2.7	2.8	3.0	3.1	3.3	3.1	2.8	2.7	2.7	2.7	2.8	2.9
11	2.7	2.8	3.0	3.1	3.3	3.1	2.8	2.7	2.7	2.7	2.8	2.9
12	2.7	2.8	3.0	3.1	3.3	3.1	2.8	2.7	2.7	2.7	2.8	2.9
13	2.7	2.8	3.0	3.1	3.3	3.1	2.7	2.7	2.7	2.7	2.8	2.9
14	2.7	2.8	3.0	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.8	2.9
15	2.7	2.9	3.1	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.8	2.9
16	2.95	3.3	3.15	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.8	2.9
17	3.35	3.45	3.2	3.1	3.3	3.1	2.7	2.7	2.7	2.7	2.8	2.8
18	3.4	3.4	3.1	3.1	3.3	3.1	2.7	2.7	2.7	2.7	3.1	2.8
19	3.6	3.25	3.15	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.95	2.8
20	3.8	3.1	3.05	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.8	2.8
21	3.65	3.0	3.05	3.1	3.3	3.0	2.7	2.7	2.7	2.7	2.8	2.8
22	3.45	3.0	3.05	3.1	3.3	3.0	2.7	2.7	2.7	2.7	3.65	2.8
23	3.3	3.0	3.05	3.1	3.3	3.0	2.7	2.7	2.7	2.7	3.6	2.8
24	3.15	2.9	3.05	3.1	3.3	2.9	2.7	2.7	2.7	2.7	3.35	2.7
25	3.1	2.9	3.1	3.35	3.3	2.9	2.7	2.7	2.7	2.7	3.3	2.7
26	3.0	2.9	3.1	3.25	3.3	2.9	2.7	2.7	2.7	2.7	3.25	2.7
27	2.9	2.9	3.1	3.9	3.5	2.9	3.0	2.7	2.7	2.7	3.1	2.7
28	2.9	2.9	3.1	3.65	3.45	2.8	3.2	2.7	2.7	2.7	3.05	2.7
29	2.9	.....	3.1	3.45	3.4	2.8	2.85	2.7	2.7	2.7	3.0	2.7
30	2.8	.....	3.1	3.3	3.4	2.8	2.8	2.7	2.7	2.7	3.0	2.8
31	2.8	.....	3.1	.....	3.4	.....	2.7	2.7	.....	2.7	.....	2.8

NOTE.—Gage heights not materially affected by ice.

UMATILLA RIVER DRAINAGE BASIN.

DESCRIPTION.

Umatilla River rises in the northeast corner of Umatilla County, Oreg., flows generally westward a distance of 80 miles, and empties into Columbia River at the town of Umatilla, Oreg. The drainage area above Pendleton spreads out in fan shape, including the western slope of the Blue Mountains for a distance of about 70 miles.

The principal tributaries are Birch, McKay, and Meacham creeks. The drainage area measures 2,130 square miles at the mouth of the river, 640 square miles at Pendleton, and 353 square miles at Gibbon.

The mean annual rainfall ranges from about 30 inches on the summit of the Blue Mountains to 9 inches at the mouth of the stream, being 14 inches at Pendleton and 25 inches at Weston, on the divide between Umatilla and Walla Walla rivers. The headwater regions of the stream are heavily forested, but downstream the forests give place to rolling table-lands devoted to wheat growing. The immediate valley of the river has been irrigated for many years, and the entire low-water flow of the stream has been appropriated for irriga-

tion. The United States Reclamation Service has completed a project to irrigate about 20,000 acres near Hermiston. The soil of this portion of the drainage basin is sandy and the climatic conditions are favorable for the production of fruit.

The bed of the river throughout its course is composed of coarse gravel, which shifts during the sudden and violent floods, changing conditions materially. The river has developed a flood plain from 100 to 500 feet in width.

UMATILLA RIVER AT GIBBON, OREG.

This station, which was established July 22, 1896, is located on the Umatilla Indian Reservation, 1 mile below Gibbon, Oreg., about 1½ miles below the mouth of Meacham Creek, and 2 miles above the mouth of Squaw Creek.

Records of flow have been kept since 1896; but they have been interrupted by destruction of the equipment by floods or through the lack of an observer. These records are of particular value to irrigation projects in the lower valley and to water-power development.

Violent floods have already destroyed several gages and cables. After each flood the conditions are so altered that it is necessary to rerate the station. The maintenance of a permanent gage datum is therefore not essential. Owing to the shifting nature of the bed at high water, crest discharges can not be determined. Estimates during flood periods have, however, been made either from facts obtained from local authorities or by comparison with the other stations farther downstream whenever it could be done with a reasonable degree of accuracy.

Discharge measurements of Umatilla River at Gibbon, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. feet.*	*Feet.*	*Sec.-ft.*
Mar. 13	H. D. McGlashan	105	162	1.50	598
Oct. 13	F. F. Henshaw	52	42	0.00	58

Daily gage height, in feet, of Umatilla River at Gibbon, Oreg., for 1909.

[Walter Swart, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.4	0.85	1.6	2.05	2.05	1.5	0.25	0.1	−0.1	0.0	0.2	2.5
2	.4	.8	1.7	1.95	2.2	1.4	.2	.1	− .1	.0	.25	2.2
3	.55	.8	1.85	1.95	2.2	1.35	.2	.1	.0	.0	.25	1.8
4	.8	.8	1.85	1.9	2.3	1.3	.2	.1	.0	.0	.25	1.45
5	.8	.8	1.8	1.75	2.0	1.2	.2	.05	− .05	.05	.25	1.25
6	.75	.8	1.75	1.65	1.9	1.15	.2	.05	− .05	.05	.25	1.1
7	.65	.75	1.7	1.6	1.8	1.1	.15	.05	− .05	.05	.25	1.05
8	.6	.75	1.6	1.7	1.7	1.0	.15	.05	− .1	.05	.25	1.45
9	.6	.75	1.6	1.8	1.65	.95	.15	.05	− .1	.05	.25	1.2
10	.55	.75	1.5	2.0	1.65	.9	.15	.05	− .1	.0	.25	1.15

Daily gage height, in feet, of Umatilla River at Gibbon, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	0.5	0.7	1.45	2.0	1.6	0.85	0.15	0.0	0.05	0.0	0.25	1.1
12	.45	.7	1.45	2.0	1.6	.85	.15	.0	.05	.0	.25	1.8
13	.45	.65	1.6	2.0	1.6	.8	.15	.0	.0	.0	.25	1.7
14	.4	.65	1.7	2.0	1.55	.75	.15	.0	− .05	.0	.25	1.7
15	.6	.7	1.76	1.95	1.55	.7	.1	.0	− .05	.0	.25	1.5
16	1.2	1.05	1.85	2.0	1.5	.65	.1	.0	− .05	.0	.25	1.3
17	1.7	2.65	2.2	2.1	1.5	.65	.1	.0	− .1	.0	.35	1.15
18	2.0	2.3	2.0	2.0	1.5	.65	.1	.0	− .1	.05	.6	1.0
19	2.8	2.0	1.8	1.85	1.5	.6	.1	− .05	− .1	.05	.9	.95
20	3.1	1.8	1.65	1.8	1.5	.6	.1	− .05	.0	.05	1.75	.85
21	2.9	1.6	1.55	1.7	1.5	.6	.1	− .05	.0	.1	1.5	.8
22	2.4	1.5	1.55	1.65	1.4	.6	.1	− .05	.0	.1	4.2	.75
23	2.0	1.4	1.5	1.65	1.35	.55	.1	− .05	.0	.1	3.8	.7
24	1.65	1.35	1.65	1.7	1.35	.5	.1	− .05	.0	.1	3.1	.65
25	1.5	1.3	1.8	1.7	1.35	.45	.1	− .05	.0	.1	2.45	.6
26	1.4	1.2	2.0	1.85	1.4	.4	.1	− .05	.0	.1	1.8	.6
27	1.25	1.2	2.1	2.65	1.95	.35	.15	− .1	.0	.1	1.6	.55
28	1.1	1.4	2.0	2.65	1.75	.35	.5	− .1	.0	.1	1.45	.55
29	1.0	.....	1.9	2.35	1.7	.3	.25	− .1	.0	.1	1.35	.5
30	.9	.....	1.9	2.15	1.6	.25	.15	− .1	.0	.1	2.53	.5
31	.85	.....	2.0	.....	1.55	.....	.1	− .1	.....	.1	.....	.5

NOTE.—Gage heights are probably not affected by ice.

Daily discharge, in second-feet, of Umatilla River at Gibbon, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	139	289	720	1,160	1,160	645	104	74	45	58	93	1,680
2	139	270	800	1,050	1,340	575	93	74	45	58	104	1,340
3	182	270	945	1,050	1,340	542	93	74	58	58	104	895
4	270	270	945	995	1,450	510	93	74	58	58	104	610
5	270	270	895	848	1,100	450	93	66	52	66	104	480
6	252	270	848	760	995	425	93	66	52	66	104	400
7	216	252	800	720	895	400	84	66	52	66	104	375
8	199	252	720	800	800	350	84	66	45	66	104	610
9	199	252	720	895	760	329	84	66	45	66	104	450
10	182	252	645	1,100	760	308	84	66	45	58	104	425
11	166	234	610	1,100	720	289	84	58	66	58	104	400
12	152	234	610	1,100	720	289	84	58	66	58	104	895
13	152	216	720	1,100	720	270	84	58	58	58	104	800
14	139	216	800	1,100	682	252	84	58	52	58	104	800
15	199	234	857	1,050	682	234	74	58	52	58	104	645
16	450	375	945	1,100	645	216	74	58	52	58	104	510
17	800	1,850	1,340	1,220	645	216	74	58	45	58	127	425
18	1,100	1,450	1,100	1,100	645	216	74	58	45	66	199	350
19	2,020	1,100	895	945	645	199	74	52	45	66	308	329
20	2,380	895	760	895	645	199	74	52	58	66	848	289
21	2,140	720	682	800	645	199	74	52	58	74	645	270
22	1,560	645	682	760	575	199	74	52	58	74	3,940	252
23	1,100	575	645	760	542	182	74	52	58	74	3,340	234
24	760	542	760	800	542	166	74	52	58	74	2,380	216
25	645	510	895	800	542	152	74	52	58	74	1,620	199
26	575	450	1,100	945	575	139	74	52	58	74	895	199
27	480	450	1,220	1,850	1,050	127	84	45	58	74	720	182
28	400	575	1,100	1,850	848	127	166	45	58	74	610	182
29	350	.....	995	1,510	800	115	104	45	58	74	542	166
30	308	.....	995	1,280	720	104	84	45	58	74	1,710	166
31	289	.....	1,100	.....	682	.....	74	45	.....	74	.....	166

NOTE.—These daily discharges are based on a rating curve that is well defined below a discharge of 1,600 second-feet.

Monthly discharge of Umatilla River at Gibbon, Oreg., for 1909.

[Drainage area, 353 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	2,380	139	588	1.67	1.92	36,200	A.
February	1,850	216	497	1.41	1.47	27,600	A.
March	1,340	610	866	2.45	2.82	53,200	A.
April	1,850	720	1,050	2.97	3.31	62,500	A.
May	1,450	542	802	2.27	2.62	49,300	A.
June	645	104	281	.796	.89	16,700	A.
July	166	74	85.2	.241	.28	5,240	B.
August	74	45	58.0	.164	.19	3,570	C.
September	66	45	53.9	.153	.17	3,210	C.
October	74	58	65.7	.186	.21	4,040	C.
November	3,940	93	651	1.84	2.05	38,700	B.
December	1,680	166	482	1.37	1.58	29,600	B.
The year	3,940	45	456.6	1.293	17.51	330,000	

UMATILLA RIVER NEAR YOAKUM, OREG.

This station was established May 5, 1903, at the Yoakum highway bridge, 1½ miles east of the Yoakum station of the Oregon Railroad & Navigation Co. and 18 miles below Pendleton, Oreg.

No tributaries enter in the immediate vicinity of the station, but water is diverted for irrigation by a number of ditches both above and below, the most important being the Horseshoe ditch, which takes water about 1 mile above the gaging site. A number of large canals take water from the river at points farther down, the largest of these being a supply canal for Cold Springs reservoir, which has recently been constructed by the United States Reclamation Service for the Umatilla project.

The gage is a split rail spiked to the south abutment of the highway bridge, from which discharge measurements are made.

The gage datum has not been changed since the station was established. Conditions are favorable for good results at all stages except extreme high water, when the banks of the stream in the vicinity of the station overflow and the entire flood plain is covered.

The following discharge measurement was made in 1909 by H. D. McGlashan:

March 12, 1909: Width, 76 feet; area, 293 square feet; gage height, 5.20 feet; discharge, 937 second-feet.

Daily gage height, in feet, of Umatilla River near Yoakum, Oreg., for 1909.

[John Doherty, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.45	.....	5.20	5.55	5.60	4.70	3.20	3.00	2.70	3.02	3.15	5.55
2	3.45	.....	5.55	5.72	5.52	4.70	3.18	2.95	2.70	2.95	3.15	.....
3	3.45	.....	5.50	5.75	5.58	4.58	3.12	2.88	2.72	3.00	3.28	5.18
4	3.45	.....	5.78	5.65	5.75	4.48	3.08	2.85	2.85	2.90	3.30	5.05
5	3.52	.....	6.00	5.42	5.68	4.38	3.0	2.85	2.80	2.92	3.30	5.02
6	3.60	.....	5.80	5.28	5.40	4.30	3.0	2.78	2.80	2.95	3.30	4.82
7	3.65	.....	5.60	5.08	5.22	4.22	3.0	2.80	2.82	2.90	3.30	4.70
8	3.70	.....	5.40	5.0	5.08	4.18	3.0	2.80	2.72	2.90	3.30	4.58
9	4.68	.....	5.40	5.08	5.0	4.10	3.0	2.75	2.72	2.95	3.25	4.55
10	5.90	.....	5.40	5.32	4.95	4.02	3.0	2.70	2.75	2.92	3.25	4.85
11	5.90	.....	5.30	5.48	4.90	3.98	3.0	2.72	2.80	2.95	3.25	4.85
12	5.90	.....	5.18	5.38	4.88	3.88	3.0	2.70	2.88	3.02	3.25	5.50
13	5.90	.....	5.10	5.45	4.85	3.80	3.0	2.70	2.85	2.95	.....	6.32
14	5.90	.....	5.20	5.60	4.88	3.78	2.95	2.68	2.85	2.90	3.40	6.20
15	5.90	.....	5.38	5.75	4.95	3.70	2.95	2.60	2.80	2.88	.....	5.75
16	5.90	.....	5.58	5.75	4.98	3.70	2.90	2.65	2.80	2.95	3.40	5.45
17	8.65	.....	5.80	5.78	5.0	3.65	2.90	2.70	2.75	2.92	3.40	5.18
18	9.70	.....	5.82	5.65	4.90	3.62	2.95	2.65	2.75	3.05	3.40	4.98
19	7.33	.....	5.55	5.50	4.85	3.60	2.85	2.65	2.80	3.05	3.52	4.78
20	7.10	.....	5.35	5.45	4.80	3.62	2.85	2.65	2.80	3.05	3.92	4.68
21	6.78	.....	5.18	5.35	4.75	3.60	2.80	2.62	2.85	3.0	4.72	4.52
22	6.52	5.00	5.02	5.18	4.70	3.52	2.80	2.60	2.90	3.0	5.10	4.45
23	5.98	4.88	4.92	5.15	4.65	3.48	2.75	2.60	2.92	3.05	7.30	4.30
24	5.42	4.65	5.02	5.10	4.50	3.42	2.72	2.65	2.92	3.0	7.40	4.20
25	5.10	4.62	5.18	5.0	4.42	3.40	2.75	2.70	2.80	3.0	6.65	4.20
26	4.85	4.70	5.38	5.28	4.40	3.40	2.75	2.70	2.80	3.0	5.98	4.10
27	4.65	4.78	5.60	5.70	4.48	3.35	2.85	2.70	2.90	3.0	5.70	4.10
28	4.48	4.88	5.65	6.28	4.72	3.35	2.92	2.70	2.85	3.05	5.25	4.0
29	4.38	.....	5.55	6.02	4.88	3.28	3.18	2.68	2.88	3.0	5.12	3.90
30	.....	.....	5.58	5.75	4.85	3.25	3.12	2.68	2.90	3.05	5.28	3.95
31	.....	.....	5.52	.....	4.72	.....	3.02	2.65	.....	3.15	.....	4.05

NOTE.—The observer's gage heights Jan. 30 to Feb. 21 are inaccurate and are not published from Jan. 10 to 18. Ice went out Jan. 18.

Daily discharge, in second-feet, of Umatilla River near Yoakum, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	142	410	1,030	1,320	1,360	700	90	62	28	65	82	1,320
2	142	363	1,320	1,470	1,290	700	87	56	28	56	82	1,170
3	142	363	1,270	1,500	1,340	628	78	47	30	62	106	1,020
4	142	363	1,530	1,400	1,500	568	72	44	44	49	110	925
5	158	363	1,750	1,200	1,430	509	62	44	38	52	110	904
6	179	363	1,550	1,090	1,180	465	62	36	38	56	110	772
7	194	318	1,360	946	1,040	421	62	38	40	49	110	700
8	208	318	1,180	890	946	401	62	38	30	49	110	628
9	688	318	1,180	946	890	363	62	33	30	56	100	610
10	990	318	1,180	1,120	855	327	62	28	33	52	100	790
11	990	298	1,100	1,250	820	310	62	30	38	56	100	790
12	990	298	1,020	1,100	808	270	62	28	47	65	100	1,270
13	990	260	900	1,220	790	242	62	28	44	56	115	2,090
14	990	200	1,030	1,300	808	235	56	26	44	49	130	1,960
15	990	298	1,100	1,500	855	208	56	20	38	47	130	1,500
16	990	386	1,340	1,500	876	208	49	24	38	56	130	1,220
17	1,510	2,920	1,550	1,530	890	194	49	28	33	52	130	1,020
18	2,020	2,180	1,570	1,400	820	185	56	24	33	68	130	876
19	2,540	1,700	1,320	1,270	790	179	44	24	38	68	158	748
20	3,060	1,400	1,140	1,220	760	185	44	24	38	68	285	688
21	2,640	1,100	1,020	1,140	730	179	38	22	44	62	712	692
22	2,320	890	904	1,020	700	158	38	20	49	62	960	550
23	1,730	808	834	995	670	148	33	20	52	68	3,340	465
24	1,200	670	904	960	580	135	30	24	52	62	3,490	410
25	960	652	1,020	890	532	130	33	28	38	62	2,480	410
26	790	700	1,160	1,090	520	130	33	28	38	62	1,730	363
27	670	748	1,360	1,450	568	120	44	28	49	62	1,450	363
28	568	808	1,400	2,050	712	120	52	28	44	68	1,060	318
29	509	.....	1,320	1,770	808	106	87	26	47	62	974	298
30	454	.....	1,340	1,500	790	100	78	26	49	68	1,090	277
31	410	.....	1,290	.....	712	.....	65	24	.....	82	.....	340

NOTE.—These daily discharges are based on a rating curve that is well defined between discharges of 20 and 7,660 second-feet. Discharges Jan. 10 to 16 reduced 40 per cent; Jan. 17 to 19 interpolated on account of ice conditions.

The daily discharges for Jan. 30 to Feb. 21 were obtained from corrected gage heights based on a relation curve between this station and that at Gibbon, and are approximate. See footnote to gage heights.

Monthly discharge of Umatilla River near Yoakum, Oreg., for 1909.

[Drainage area, 1,200 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	3,060	142	978	0.815	0.94	60,100	C.
February	2,920	260	710	.592	.62	39,400	C.
March	1,750	834	1,230	1.02	1.18	75,600	A.
April	2,050	890	1,270	1.06	1.18	75,600	A.
May	1,500	520	883	.736	.85	54,300	A.
June	700	100	287	.239	.27	17,100	A.
July	90	30	57.1	.048	.06	3,510	C.
August	62	20	30.8	.026	.03	1,890	C.
September	52	28	39.7	.033	.04	2,360	C.
October	82	47	59.7	.050	.06	3,670	C.
November	3,490	82	657	.548	.61	39,100	A.
December	2,090	277	819	.682	.79	50,400	A.
The year	3,490	20	585	.487	6.63	423,000	

UMATILLA RIVER NEAR UMATILLA, OREG.

This station, which was established October 21, 1903, is located about 1½ miles above the mouth of the river, about 1¼ miles above Umatilla, Oreg., about one-half mile below the diversion dam of the Oregon Land & Water Co.'s canal, and one-fourth mile above the head gate of the Brownell ditch.

Records at this point show the quantity of water flowing into Columbia River after the irrigation requirements have been satisfied.

The gage is on the left bank and is in two sections, both of which are sloping and bolted securely into rock. Discharge measurements are made from a cable equipment 45 feet above the gage. It is equipped with a stay line for flood work.

The natural conditions affecting the flow during open water at this station are exceptionally good. The stream bed is nearly flat from bank to bank and is free from débris; the bed and banks for a long distance above and below the station are on solid rock; the velocity of the water is sufficiently swift to prevent the deposition of silt or sand, and even at extreme floods the water is all confined within the banks of the stream. Sufficient discharge measurements have been made to develop an absolutely permanent rating curve covering a range of stage from 0 to 11,000 second-feet. Ice is likely to affect the discharge considerably during the winter months.

An ice jam took out the lower portion of the inclined gage about January 17 or 18, 1909. This was not repaired during the year. The observer made his readings by the use of a portion of the gage that remained intact, holding it on the same slope. The gage heights for 1909 below 3.5 feet are, however, subject to error and the daily and monthly estimates, which are based on them, are therefore not as good as they should be.

No discharge measurements were made during 1909.

Daily gage height, in feet, of Umatilla River near Umatilla, Oreg., for 1909.

[W. A. Walpole and N. E. Newton, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.35	3.0	3.5	3.6	3.7	2.9	1.5	1.6	1.6	1.7	2.8	3.7
2	2.35	.....	3.8	3.7	3.5	2.9	.....	1.6	.....	1.8	.....	.....
3	.....	3.0	.....	3.7	3.5	2.9	1.5	1.6	1.6	1.8	3.0	3.6
4	2.3	.....	4.0	3.6	3.6	2.9	.....	1.6	.....	.....	.....	.....
5	.....	.....	.....	3.5	3.7	2.9	1.5	1.6	1.6	2.0	3.0	3.6
6	2.3	3.0	3.8	3.4	3.6	2.8	.....	1.6	.....	.....	.....	.....
7	.....	.....	.....	3.4	3.5	2.9	1.5	1.6	1.6	2.1	3.0	3.7
8	.....	.....	3.6	3.4	3.5	2.9	.....	1.6	.....	.....	.....	.....
9	2.3	.....	.....	3.3	3.3	2.9	1.5	1.6	1.6	2.3	3.0	3.6
10	.....	2.5	.....	3.3	3.2	2.9	.....	.....	.....	.....	.....	.....
11	.....	.....	3.6	3.5	3.1	2.9	1.5	1.6	1.6	2.4	3.0	3.5
12	.....	.....	.....	3.5	3.1	2.8	.....	.....	.....	.....	.....	.....
13	.....	.....	3.4	3.5	3.1	2.7	1.5	1.6	1.6	2.4	3.0	3.6
14	.....	3.35	.....	3.5	3.1	2.7	.....	.....	.....	.....	.....	.....
15	.....	.....	3.4	3.6	3.1	2.7	1.5	1.6	1.6	2.3	3.0	3.7
16	.....	3.9	.....	3.7	3.1	2.6	.....	.....	.....	.....	.....	.....
17	.....	.....	3.6	3.7	3.1	2.6	1.5	1.6	1.6	2.3	2.8	3.6
18	.....	4.0	.....	3.7	3.1	2.6	1.4	.....	.....	.....	.....	.....
19	6.0	.....	3.6	3.7	3.1	2.5	1.4	1.6	1.6	2.3	2.8	3.4
20	.....	3.7	3.5	3.6	3.2	2.0	1.4	.....	.....	.....	.....	.....
21	4.7	.....	.....	3.5	3.1	2.0	1.4	1.6	1.6	2.4	3.0	3.2
22	.....	3.4	3.3	3.4	3.0	1.5	2.0	.....	.....	.....	.....	.....
23	.....	.....	3.2	3.4	3.0	1.5	1.8	1.6	1.6	2.4	4.2	3.2
24	.....	.....	3.2	3.3	3.0	1.5	1.8	.....	.....	.....	.....	.....
25	4.0	3.1	3.3	3.3	3.0	1.5	1.8	1.6	1.6	2.5	4.0	3.2
26	.....	.....	3.4	3.2	2.9	1.5	1.7	.....	.....	.....	.....	.....
27	3.6	3.0	3.5	3.6	2.8	1.5	1.7	1.6	1.7	2.6	3.6	3.2
28	.....	.....	3.6	3.95	2.9	.....	1.7	.....	.....	.....	.....	.....
29	.....	.....	3.7	4.1	2.8	1.5	1.7	1.6	1.7	2.6	3.5	3.1
30	3.0	.....	3.6	3.8	2.9	.....	1.6	.....	.....	.....	.....	.....
31	.....	.....	3.6	.....	3.0	.....	1.6	1.6	.....	2.6	.....	3.1

NOTE.—The lower portion of the inclined gage was taken out by an ice jam Jan. 17 or 18, and was not replaced during the year. All readings below 3.5 feet are approximate. Ice from Jan. 9 to Jan. 17 or 18.

Daily discharge, in second-feet, of Umatilla River near Umatilla, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	58	340	770	880	995	270	0.5	0.7	0.7	1.5	210	995
2	58	340	1,120	995	770	270	.5	.7	.7	3.5	275	938
3	54	340	1,250	995	770	270	.5	.7	.7	3.5	340	880
4	49	340	1,380	880	880	270	.5	.7	.7	8.8	340	880
5	49	340	1,250	770	995	270	.5	.7	.7	14	340	880
6	49	340	1,120	670	880	210	.5	.7	.7	18	340	938
7	49	278	1,000	670	770	270	.5	.7	.7	22	340	995
8	49	215	880	670	770	270	.5	.7	.7	36	340	938
9	49	152	880	580	590	270	.5	.7	.7	49	340	880
10	400	90	880	580	495	270	.5	.7	.7	58	340	825
11	700	224	880	770	415	270	5	.7	.7	68	340	770
12	700	358	775	770	415	210	.5	.7	.7	68	340	825
13	700	491	670	770	415	160	.5	.7	.7	68	340	880
14	700	625	670	770	415	160	.5	.7	.7	58	340	938
15	700	935	670	880	415	160	.5	.7	.7	49	340	995
16	700	1,240	775	995	415	120	.5	.7	.7	49	275	938
17	1,000	1,310	880	995	415	120	.5	.7	.7	49	210	880
18	3,000	1,380	880	995	415	120	.4	.7	.7	49	210	775
19	4,910	1,190	880	995	415	90	.4	.7	.7	49	210	670
20	3,680	995	770	880	495	14	4	.7	.7	58	275	582
21	2,450	832	675	770	415	14	.4	.7	.7	68	340	495
22	2,180	670	580	670	340	.5	14	.7	.7	68	1,000	495
23	1,920	585	495	670	340	.5	3.5	.7	.7	68	1,660	495
24	1,650	500	495	580	340	.5	3.5	.7	.7	79	1,570	495
25	1,380	415	580	580	340	.5	3.5	.7	.7	90	1,380	495
26	1,130	378	670	495	270	.5	1.5	.7	1.1	105	1,130	495
27	880	340	770	880	210	.5	1.5	.7	1.5	120	880	495
28	700	555	880	1,310	270	.5	1.5	.7	1.5	120	625	455
29	520	.....	995	1,520	270	.5	1.5	.7	1.5	120	770	415
30	340	.....	880	1,120	270	.5	.7	.7	1.5	120	880	415
31	340	.....	880	.....	340	.....	.7	.7	.....	120	.....	415

NOTE.—These discharges were obtained from a rating curve that is well defined. Discharges Jan. 10 to 18 estimated, on account of ice conditions. Discharges interpolated for days when gage was not read.

Monthly discharge of Umatilla River near Umatilla, Oreg., for 1909.

[Drainage area, 2,130 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	4,910	49	1,000	0.469	0.54	61,500	C.
February	1,380	90	564	.265	.28	31,300	B.
March	1,380	495	848	.398	.46	52,100	A.
April	1,520	495	837	.393	.44	49,800	A.
May	995	210	501	.235	.27	30,800	A.
June	270	.5	136	.064	.071	8,090	B.
July	14	.4	1.37	.00064	.0007	84	C.
August	.7	.7	.70	.00033	.0004	43	D.
September	1.5	.7	.82	.00038	.0004	49	D.
October	120	1.5	59.9	.028	.03	3,680	C.
November	1,660	210	544	.255	.28	32,400	A.
December	995	415	728	.342	.39	44,800	A.
The year	4,910	.4	435	.200	2.76	315,000	

JOHN DAY RIVER DRAINAGE BASIN.

DESCRIPTION.

John Day River drains the country to the northwest of the Blue Mountains. The river rises on the divide between Grant and Baker counties, Oreg., flows westward and then northward, and joins Columbia River about 28 miles above The Dalles. Its principal tributaries are the North, Middle, and South forks. Its total drainage area is 7,800 square miles.

The general elevation of its headwaters is about 6,000 feet above sea level; at Fossil the elevation is 1,500 feet. The headwater region of the stream is forested. Except wheat, which is grown on the rolling uplands by the "dry farming" process, no agricultural products of consequence can be raised without irrigation, and as the areas which admit of easy irrigation are confined to the immediate valleys of the streams, comparatively little has been done in this direction. A number of projects are, however, contemplated, under which, by means of storage reservoirs and high-line canals, enormous areas of very productive table-lands would be developed. The storage facilities are ample for this purpose. It is not likely that extensive development will be undertaken until more detailed studies of flow have been made.

The mean annual rainfall varies from 24 inches on the headwaters to 10 inches at the mouth. The winters are cold, and the streams are frequently icebound throughout the greater part of the winter.

JOHN DAY RIVER NEAR DAYVILLE, OREG.

This station, which is located at a private wagon bridge on K. F. MacRae's ranch, 3 miles above Dayville, Oreg., and 3 miles above the mouth of the South Fork of John Day River, was established November 23, 1908, to obtain data for the study of the possibilities of irrigation from this stream by means of storage, as a number of excellent reservoir sites are found on the river above this point.

The vertical staff gage is bolted to the center pier of the bridge from which discharge measurements are made.

Discharge measurements of John Day River near Dayville, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1908.					
Nov. 23	R. B. Post	40	62	0.55	154
1909.					
Mar. 7	R. B. Post	46	102	1.34	327
July 18	do	29	47.5	.18	83.4

Daily gage height, in feet, of John Day River near Dayville, Oreg., for 1909.

[K. F. MacRae, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.4	0.9	1.3	2.0	1.6	2.6	1.1	0.1	−0.4	0.1	0.3	1.2
2	.4	.95	1.3	2.1	1.6	2.7	1.0	.0	− .3	.1	.4	1.2
3	.42	.95	1.3	2.5	1.8	3.0	.9	.0	− .3	.0	.4	.9
4	.56	1.0	1.45	2.3	1.9	3.5	.5	.0	.0	.1	.4	.7
5	.5	1.0	1.5	2.0	2.1	3.2	.4	.0	.0	.2	.4	.6
6	.5	1.0	1.5	1.9	2.0	3.0	.4	.0	.0	.2	.4	.6
7	.5	.9	1.4	1.9	1.9	2.5	.4	.0	.0	.2	.4	.9
8	.5	.9	1.4	1.8	1.9	2.5	.5	.0	.0	.3	.4	1.0
9	.5	.85	1.45	1.7	1.9	2.5	.8	.0	− .1	.3	.4	1.0
10	3.0	.85	1.4	1.7	1.8	2.45	.9	− .1	.0	.3	.4	1.0
11	3.0	.75	1.4	1.8	1.8	2.0	.9	− .1	.0	.3	.5	1.0
12	3.0	.8	1.4	1.8	1.8	1.8	.9	− .1	.0	.2	.5	1.0
13	3.0	.9	1.35	1.85	1.8	1.9	.8	− .2	.0	.2	.5	1.1
14	3.0	1.0	1.35	2.0	1.8	1.9	.8	− .2	.0	.2	.5	1.1
15	3.0	1.0	1.35	2.0	1.7	1.8	.8	− .2	.0	.2	.4	1.1
16	3.0	1.0	1.6	2.0	1.7	2.0	.8	− .2	.0	.2	.4	1.0
17	2.8	3.3	1.6	2.0	1.5	1.8	.5	− .2	.0	.2	.3	.9
18	2.8	2.1	1.8	2.0	1.5	1.8	.35	− .2	.0	.3	.3	.9
19	2.1	1.9	1.95	1.95	1.5	1.8	.25	− .2	.0	.3	.4	.9
20	3.0	1.9	1.8	1.95	1.6	1.8	.2	− .3	.0	.3	.4	.8
21	2.9	1.5	1.8	1.9	1.7	1.8	.2	− .3	.0	.3	.9	.8
22	2.9	1.4	1.75	1.8	1.75	1.8	.15	− .3	.0	.3	1.0	.5
23	2.0	1.45	1.7	1.8	1.8	1.6	.15	− .4	.0	.3	2.3	.4
24	1.6	1.5	1.7	1.6	1.8	1.5	.15	− .4	.0	.3	2.7	.4
25	1.5	1.5	1.9	1.7	1.8	1.4	.0	− .5	.0	.3	1.8	.4
26	1.45	1.45	1.95	1.7	1.8	1.3	.0	− .5	.0	.3	1.6	.4
27	1.35	1.45	2.0	1.8	1.8	1.2	.01	− .5	.0	.3	1.2	.3
28	1.0	1.4	2.1	1.9	2.05	1.2	.05	− .5	.0	.3	1.2	.3
29	.8	.....	2.05	1.9	2.9	1.2	.05	− .5	.0	.3	1.3	.3
30	.8	.....	2.0	1.8	2.8	1.1	.1	− .4	.1	.3	1.2	.3
31	.9	.....	2.0	.....	2.6	.....	.1	− .4	.....	.3	.....	.3

Daily discharge, in second-feet, of John Day River near Dayville, Oreg., for 1908–9.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	122	11	.....	125	21	.....	136
2	.....	125	12	.....	140	22	.....	140
3	.....	125	13	.....	140	23	.....	140
4	.....	140	14	.....	140	24	140	140
5	.....	140	15	.....	125	25	140	125
6	.....	125	16	.....	125	26	125	125
7	.....	125	17	.....	122	27	122	125
8	.....	125	18	.....	125	28	122	125
9	.....	125	19	.....	128	29	122	125
10	.....	125	20	.....	132	30	122	125
						31	.....	122

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	122	222	320	540	410	770	270	80	29	80	106	295
2	122	234	320	575	410	810	245	69	39	80	122	295
3	126	234	320	730	470	960	222	69	39	69	122	222
4	152	245	365	650	505	1,230	140	69	69	80	122	180
5	140	245	380	540	575	1,060	122	69	69	92	122	160
6	140	245	380	505	540	960	122	69	69	92	122	160
7	140	222	350	505	505	730	122	69	69	92	122	222
8	140	222	350	470	505	730	140	69	69	106	122	245
9	140	211	365	440	505	730	200	69	59	106	122	245
10	184	211	350	440	470	710	222	59	69	106	122	245
11	227	190	350	470	470	540	222	59	69	106	140	245
12	270	200	350	470	470	470	222	59	69	92	140	245
13	314	222	335	488	470	505	200	49	69	92	140	270
14	358	245	335	540	470	505	200	49	69	92	140	270
15	401	245	335	540	440	470	200	49	69	92	122	270
16	444	245	410	540	440	540	200	49	69	92	122	245
17	488	1,120	410	540	380	470	140	49	69	92	106	222
18	532	575	470	540	380	470	114	49	69	106	106	222
19	575	505	522	522	380	470	99	49	69	106	122	222
20	960	505	470	522	410	470	92	39	69	106	122	200
21	910	380	470	505	440	470	92	39	69	106	222	200
22	910	350	455	470	455	470	86	39	69	106	245	140
23	540	365	440	470	470	410	86	29	69	106	650	122
24	410	380	440	410	470	380	86	29	69	106	810	122
25	380	380	505	440	470	350	69	20	69	106	470	122
26	365	365	522	440	470	320	69	20	69	106	410	122
27	335	365	540	470	470	295	70	20	69	106	295	106
28	245	350	575	505	558	295	74	20	69	106	295	106
29	200	.....	558	505	910	295	74	20	69	106	320	106
30	200	.....	540	470	860	270	80	29	80	106	295	106
31	222	.....	540	.....	770	.....	80	29	.....	106	.....	106

NOTE.—These discharges are based on a rating curve that is fairly well defined between 92 and 350 second-feet. Jan. 10 to 18, 1909, interpolated on account of ice conditions.

Monthly discharge of John Day River near Dayville, Oreg., for 1908–9.

[Drainage area, 1,000 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
November 24–30	140	122	128	0.128	0.033	1,780	A.
December	140	122	129	.129	.149	7,930	B.
1909.							
January	960	122	345	.345	.40	21,200	C.
February	1,120	190	331	.331	.34	18,400	B.
March	575	320	422	.422	.49	25,900	A.
April	730	410	508	.508	.57	30,200	A.
May	910	380	502	.502	.58	30,900	A.
June	1,230	270	572	.572	.64	34,000	A.
July	270	69	141	.141	.16	8,670	A.
August	80	20	47.9	.048	.06	2,950	C.
September	80	29	65.7	.066	.07	3,910	C.
October	106	69	98.2	.098	.11	6,040	B.
November	810	106	216	.216	.24	12,900	B.
December	295	106	195	.195	.22	12,000	B.
The year	1,230	20	287	.287	3.88	207,000	

JOHN DAY RIVER AT M'DONALD, OREG.

This station, which is located at McDonald Ferry and post office, 16 miles above the mouth of the stream, and one-half mile below the mouth of Rock Creek, was established December 16, 1904, to determine the amount of water available for irrigation and water-power development. Storage reservoirs must, however, be constructed to equalize the flow of the stream, which in its natural condition is subject to wide fluctuations. The winter gage heights are sometimes affected for short periods by ice.

The general conditions at the station are exceptionally favorable, and what appears to be an absolutely permanent rating curve has been established.

An inclined gage is bolted to bridge timbers on the left bank 180 feet upstream from the cable from which discharge measurements are made. The datum of the gage has not been changed. The observations of gage height are exceptionally good, and the discharge data are reliable. No discharge measurements were made during 1909.

Daily gage height, in feet, of John Day River at McDonald, Oreg., for 1909.

[Wm. Murray, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.85	2.3	2.9	4.1	4.1	4.3	2.4	1.6	1.2	1.5	1.6	2.9
2	1.75	2.3	3.0	4.1	3.9	4.35	2.3	1.7	1.2	1.5	1.65	3.2
3	1.82	2.3	3.25	4.3	3.9	4.75	2.2	1.62	1.2	1.45	1.70	3.1
4	1.85	2.3	3.45	4.5	4.0	4.9	2.2	1.60	1.2	1.45	1.70	3.88
5	1.9	2.3	3.45	4.5	4.35	4.75	2.1	1.55	1.25	1.52	1.7	2.6

Daily gage height, in feet, of John Day River at McDonald, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
6	1.9	2.3	3.65	4.2	4.75	4.6	2.0	1.5	1.32	1.55	1.7	2.45
7	1.8	2.22	3.45	4.0	4.55	4.45	2.0	1.5	1.3	1.55	1.75	2.18
8	2.55	2.2	3.3	3.8	4.35	4.25	2.0	1.45	1.75	1.55	1.8	2.4
9	2.3	2.2	3.15	3.6	4.25	4.0	2.0	1.45	1.52	1.55	1.8	2.5
10	2.05	2.2	3.1	3.55	4.1	3.85	2.0	1.4	1.5	1.55	1.8	2.65
11	1.9	2.2	3.1	3.65	4.1	3.75	2.35	1.4	1.5	1.55	1.8	2.95
12	1.85	2.2	3.0	4.0	4.1	3.55	2.1	1.4	1.5	1.58	1.8	2.95
13	1.85	2.2	2.9	3.8	4.0	3.45	2.05	1.4	1.5	1.6	1.8	3.3
14	2.1	2.1	2.85	3.8	3.9	3.4	2.05	1.35	1.45	1.60	1.8	3.0
15	2.0	2.15	2.95	4.1	3.9	3.5	2.0	1.35	1.45	1.55	1.8	3.3
16	2.0	2.35	3.15	4.3	3.8	3.4	1.9	1.3	1.45	1.55	1.8	2.95
17	2.1	2.65	3.5	4.3	3.8	3.4	1.8	1.3	1.48	1.55	1.8	2.95
18	6.05	4.05	3.9	4.4	3.8	3.5	1.8	1.3	1.5	1.55	1.8	2.5
19	5.15	4.2	4.1	4.35	3.8	3.3	1.8	1.3	1.45	1.55	1.68	2.5
20	4.2	3.85	3.75	4.1	3.7	3.35	1.75	1.3	1.45	1.55	1.68	2.5
21	5.2	3.55	3.6	4.1	3.68	3.3	1.7	1.3	1.45	1.55	1.6	2.5
22	4.75	3.2	3.5	4.1	3.7	3.2	1.7	1.3	1.4	1.55	1.92	2.4
23	4.45	3.05	3.38	3.9	3.7	3.1	1.7	1.25	1.4	1.55	2.45	2.4
24	3.65	2.9	3.3	3.8	3.6	2.95	1.7	1.25	1.4	1.60	5.05	2.25
25	3.2	2.9	3.4	3.9	3.5	2.8	1.6	1.25	1.4	1.60	5.4	1.95
26	2.9	2.9	3.7	3.7	3.4	2.7	1.6	1.25	1.4	1.60	4.35	2.15
27	2.7	3.0	3.95	3.8	3.5	2.7	1.55	1.25	1.45	1.60	3.75	2.25
28	2.7	2.9	4.25	4.05	3.7	2.6	1.58	1.2	1.5	1.60	3.35	2.45
29	2.5	.....	4.4	4.45	4.25	2.5	1.5	1.2	1.5	1.60	3.05	2.45
30	2.4	.....	4.4	4.35	4.65	2.5	1.5	1.2	1.5	1.60	2.82	2.45
31	2.25	.....	4.3	.....	4.45	.....	1.55	1.2	.....	1.6	.....	2.45

NOTE.—The lower section of the gage was carried away by ice Jan. 17. A new section was put in place by the observer Jan. 24. Gage readings made by measuring down from the 8-foot mark. Ice conditions from about Jan. 7 to 21. Ice broke up Jan. 17.

Daily discharge, in second-feet, of John Day River at McDonald, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	422	810	1,480	3,440	3,440	3,870	910	260	93	210	260	1,480
2	352	810	1,620	3,440	3,050	3,980	810	320	93	210	290	1,890
3	400	810	1,960	3,870	3,050	4,900	715	272	93	188	320	1,750
4	422	810	2,260	4,320	3,240	5,260	715	260	93	188	320	3,010
5	460	810	2,260	4,320	3,980	4,900	625	235	109	220	320	1,120
6	460	810	2,600	3,650	4,900	4,550	540	210	133	235	320	962
7	346	734	2,200	3,240	4,440	4,200	540	210	125	235	352	697
8	963	715	2,040	2,870	3,980	3,760	540	188	352	235	385	910
9	729	715	1,820	2,520	3,760	3,240	540	188	220	235	385	1,020
10	524	715	1,750	2,430	3,440	2,960	540	165	210	235	385	1,180
11	414	715	1,750	2,600	3,440	2,780	860	165	210	235	385	1,550
12	380	715	1,620	3,240	3,440	2,430	625	165	210	250	385	1,550
13	380	715	1,480	2,870	3,240	2,260	582	165	210	260	385	2,040
14	562	625	1,420	2,870	3,050	2,180	582	145	188	260	385	1,620
15	486	670	1,550	3,440	3,050	2,340	540	145	188	235	385	2,040
16	486	860	1,820	3,870	2,870	2,180	460	125	188	235	385	1,550
17	562	1,180	2,340	3,870	2,870	2,180	385	125	188	235	385	1,300
18	6,220	3,340	3,050	4,090	2,870	2,340	385	125	210	235	385	1,020
19	4,410	3,650	3,440	3,980	2,870	2,040	385	125	188	235	308	1,020
20	3,650	2,900	2,780	3,440	2,690	2,110	352	125	188	235	308	1,020
21	4,500	2,430	2,520	3,440	2,660	2,040	320	125	188	235	260	1,020
22	4,900	1,890	2,340	3,440	2,690	1,890	320	125	165	235	476	910
23	4,200	1,680	2,160	3,050	2,690	1,750	320	109	165	235	962	910
24	2,600	1,480	2,040	2,870	2,520	1,550	320	109	165	260	5,620	762
25	1,890	1,480	2,180	3,050	2,340	1,360	260	109	165	260	6,520	500
26	1,480	1,480	2,690	2,690	2,180	1,240	260	109	165	260	3,980	670
27	1,240	1,620	3,140	2,870	2,340	1,240	235	109	188	260	2,780	762
28	1,240	1,480	3,760	3,340	2,690	1,120	250	93	210	260	2,110	962
29	1,020	.....	4,090	4,200	3,760	1,020	210	93	210	260	1,680	962
30	910	.....	4,090	3,980	4,660	1,020	210	93	210	260	1,380	962
31	762	.....	3,870	.....	4,200	.....	225	93	.....	260	.....	962

NOTE.—These discharges are based on a rating curve that is well defined between 90 and 10,200 second feet. Discharges Jan. 7 to 17 reduced 10 per cent, Jan. 18, 19, and 21 reduced 25 per cent to allow for ice conditions.

Monthly discharge of John Day River at McDonald, Oreg., for 1909.

[Drainage area, 7,800 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	6,220	346	1,530	0.196	0.23	94,100	C.
February	3,650	625	1,310	.168	.17	72,800	A.
March	4,090	1,420	2,390	.306	.35	147,000	A.
April	4,320	2,430	3,380	.433	.48	201,000	A.
May	4,900	2,180	3,240	.415	.48	199,000	A.
June	5,230	1,020	2,620	.336	.37	156,000	A.
July	910	210	470	.060	.07	28,900	A.
August	320	93	158	.020	.02	9,720	A.
September	352	93	177	.023	.03	10,500	A.
October	260	158	238	.031	.04	14,600	A.
November	6,520	260	1,090	.140	.16	64,900	A.
December	3,010	500	1,230	.158	.18	75,600	A.
The year	6,520	93	1,490	.190	2.58	1,070,000	

SOUTH FORK OF JOHN DAY RIVER AT DAYVILLE, OREG.

This station was established November 21, 1908. It is located one-half mile above Dayville and 1 mile above the mouth of the stream. The Dayville ditch diverts water about one-fourth mile above the station, and the flow in the ditch should be included in that of the main river to determine the natural flow at this point.

The vertical staff gage is fastened to an alder on the left bank about 10 feet above the cable, from which discharge measurements are made.

The data obtained will be of value in determining the amount of water available for irrigation, as facilities for storing a large portion of the annual flow are afforded above this point.

Discharge measurements of South Fork of John Day River at Dayville, Oreg., in 1908-9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Nov. 22	R. B. Post	71	51	0.46	41
1909.					
Mar. 6	do	73	101	1.10	187
July 18	do	58	32.5	.21	23.3

Daily gage height, in feet, of South Fork of John Day River at Dayville, Oreg., for 1909.

[J. Campbell Martin, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.44	0.69	1.08	1.60	1.31	0.93	0.32	0.17	0.02	0.21	0.23	0.70
2	.43	.65	1.15	1.80	1.29	.89	.30	.16	.03	.21	.27	.68
3	.48	.67	1.20	1.88	1.31	.81	.29	.13	.85	.22	.30	.56
4	.48	.67	1.23	1.80	1.39	.79	.29	.11	.40	.22	.29	.36
5	.39	.67	1.21	1.70	1.34	.75	.24	.08	.45	.22	.32	.51
6	.39	.65	1.12	1.62	1.31	.75	.29	.08	.35	.24	.36	.51
7	.59	.60	1.08	1.53	1.30	.71	.31	.08	.25	.25	.36	.51
8	.61	.55	1.05	1.46	1.22	.73	.31	.04	.25	.22	.34	.58
9	.30	.60	1.02	1.50	1.20	.72	.29	.02	.20	.22	.38	.80
10		.60	.94	1.55	1.17	.72	.37	.02	.20	.23	.38	.65

Daily gage height, in feet, of South Fork of John Day River at Dayville, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	0.48	0.90	1.52	1.17	0.72	0.37	0.02	0.20	0.23	0.38	0.60
12	.....	.52	.89	1.51	1.17	.68	.34	.02	.20	.23	.36	.75
13	.....	.99	.99	1.61	1.12	.65	.29	.02	.20	.23	.37	1.09
14	0.70	.89	1.28	1.74	1.08	.63	.25	.02	.20	.23	.36	.76
15	.80	.90	1.39	1.70	1.06	.65	.27	.02	.18	.23	.32	.60
16	1.38	1.70	1.56	1.70	1.04	.63	.24	.01	.18	.23	.30	.59
17	1.58	2.15	1.64	1.71	1.03	.63	.23	.02	.18	.23	.33	.64
18	1.50	2.10	1.42	1.65	1.00	.67	.21	.02	.18	.23	.36	.60
19	1.99	1.42	1.38	1.60	.97	.61	.20	.02	.18	.23	.37	.59
20	2.09	1.20	1.35	1.56	.95	.61	.20	.02	.18	.25	.38	.56
21	1.89	1.09	1.33	1.50	.90	.60	.19	.02	.18	.26	.48	.50
22	1.49	1.00	1.28	1.45	.90	.56	.18	.02	.20	.24	2.10	.59
23	.99	.95	1.25	1.45	.89	.51	.15	.02	.20	.24	3.20	.51
24	.90	1.01	1.60	1.42	.85	.50	.15	.01	.20	.24	1.65	.58
25	.91	.99	1.60	1.38	.81	.48	.15	.02	.20	.23	1.20	.55
26	.80	.91	1.60	1.40	.81	.48	.15	.03	.20	.23	.95	.50
27	.60	.85	1.65	1.42	1.00	.41	.20	.03	.19	.25	.80	.49
28	.60	.98	1.78	1.42	1.16	.39	.20	.04	.19	.23	.73	.49
29	.60	.....	1.89	1.41	1.06	.38	.20	.02	.20	.23	.70	.49
30	.60	.....	1.66	1.40	.97	.35	.18	.02	.21	.21	.45	.50
31	.69	.....	1.62	.....	.94	.....	.18	.02	.....	.21	.....	.53

NOTE.—River blocked with ice Jan. 7, frozen over Jan. 9 with ice 8 inches thick. Ice broke up Jan. 17.

Daily discharge, in second-feet, of South Fork of John Day River at Dayville, Oreg., for 1908–9.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	39	11	.....	37	21	.....	42
2	.....	41	12	.....	42	22	45	42
3	.....	41	13	.....	41	23	49	39
4	.....	41	14	.....	38	24	49	39
5	.....	45	15	.....	32	25	49	39
6	.....	41	16	.....	37	26	49	39
7	.....	41	17	.....	38	27	38	39
8	.....	41	18	.....	37	28	37	45
9	.....	41	19	.....	42	29	26	45
10	.....	41	20	.....	42	30	39	36
						31	.....	44

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	44	86	189	365	254	140	28	15	5	18	20	88
2	46	78	200	445	246	129	26	14	6	18	23	84
3	49	82	215	481	254	111	25	12	120	19	26	62
4	49	82	297	450	282	107	25	11	38	19	25	33
5	51	82	218	405	264	98	21	9	45	19	28	54
6	37	78	191	373	254	98	25	9	32	21	33	62
7	67	69	180	337	250	90	27	9	22	22	33	54
8	71	60	172	309	222	94	27	6	22	19	31	66
9	26	69	163	325	215	92	25	5	17	19	36	109
10	36	69	142	345	206	92	34	5	17	20	36	78
11	46	49	132	333	206	92	34	5	17	20	36	69
12	59	55	130	329	206	84	31	5	17	20	33	98
13	73	155	155	369	191	78	25	5	17	20	34	182
14	88	130	243	421	180	75	24	5	17	20	33	101
15	109	132	282	405	174	78	23	5	16	20	28	69
16	278	405	349	405	169	75	21	5	16	20	26	67
17	357	605	381	409	166	75	20	5	16	20	30	77
18	325	580	293	385	158	82	18	5	16	20	33	69
19	530	293	278	365	150	71	17	5	16	20	34	67
20	576	215	268	349	145	71	17	5	16	22	36	62

Daily discharge, in second-feet, of South Fork of John Day River at Dayville, Oreg., for 1908–9—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
21	486	182	260	325	132	69	16	5	16	22	49	52
22	321	158	243	305	132	62	16	5	17	21	580	67
23	155	145	232	305	130	54	14	5	17	21	1,190	54
24	132	161	365	293	120	52	14	5	17	21	385	66
25	135	155	365	278	111	49	14	5	17	20	215	60
26	109	135	365	285	111	49	14	6	17	20	145	52
27	69	120	385	293	158	39	17	6	16	22	109	51
28	69	153	437	293	203	37	17	6	16	20	94	51
29	69	.....	445	289	174	36	17	5	17	20	88	51
30	69	.....	389	285	150	33	16	5	18	18	45	52
31	86	.....	373	.....	142	.....	16	5	.....	18	.....	57

NOTE.—These discharges are based on a rating curve that is fairly well defined between 17 and 185 second-feet. Discharges Jan. 10 to 13, 1909, interpolated to allow for ice conditions.

Monthly discharge of South Fork of John Day River at Dayville, Oreg., for 1908–9.

[Drainage area, 600 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
November 22–30	49	26	42.3	0.070	0.02	755	B.
December	45	32	40.2	.067	.08	2,470	B.
1909.							
January	576	26	149	.248	.29	9,160	B.
February	605	49	164	.273	.28	9,110	A.
March	445	130	269	.448	.52	16,500	A.
April	481	285	352	.587	.65	20,900	A.
May	282	111	186	.310	.36	11,400	A.
June	140	33	77.1	.128	.14	4,590	B.
July	34	14	21.4	.036	.04	1,320	B.
August	15	5	6.55	.011	.01	403	C.
September	120	5	21.9	.036	.04	1,300	B.
October	22	18	20	.033	.04	1,230	B.
November	1,190	20	117	.195	.22	6,960	B.
December	182	33	69.8	.116	.13	4,290	B.
The year	1,190	5	121	.202	2.72	87,200	

DESCHUTES RIVER DRAINAGE BASIN.

DESCRIPTION.

Deschutes River has its source in a number of mountain lakes at the summit of the Cascade Range just east of the waters of Willamette River in Klamath and Crook counties, Oreg. Its course is northward to Columbia River, which it enters about 15 miles above The Dalles.

The principal tributaries of Deschutes River are White, Warm Springs, Metolius, and Crooked rivers, and the West Fork of the Deschutes. All except Crooked River drain the eastern slope of the Cascades and contribute the larger portion of the stream flow.

The entire drainage area of the system is 9,180 square miles, distributed as follows:

Area of Deschutes River drainage basin.

	Square miles.
Deschutes at Bend	1,530
Deschutes above the mouth of Crooked River	2,520
Deschutes at Sherar Bridge	8,750
Deschutes River above Lava post office (locally known as Little River)	720
Crooked River	2,920
East Fork of Deschutes River	200
West Fork of Deschutes River	500

Topographically the area is rough and mountainous. The agricultural lands consist largely of high table-lands cut by deep canyons through which the rivers flow, and small arable areas which border the streams. The soil is a coarse disintegrated lava. The rocks of the entire area are volcanic and so peculiarly porous that the basin acts like a huge sponge in the matter of ground storage. Deschutes River has perhaps the most remarkable uniform flow of any river comparable with it in size, and its economic value is almost incalculable. At the mouth of the stream the maximum flow is six times and at Bend only three times the minimum. Ocular evidence of this uniformity of flow is presented by the low grass-grown banks between which the river flows throughout its upper portions.

The general elevation of the lands around Bend is 3,600 feet above sea level; that of the summit of the Cascade Mountains is from 5,000 to 6,000 feet. Prineville is 2,868 feet above sea level, and Paulina, near the upper portion of the Crooked River drainage basin, 3,684 feet.

The timbered portion of this drainage basin is found on the eastern slope of the Cascades and on the headwaters of Crooked River.

The annual rainfall varies from 100 inches on the summit of the Cascade Mountains to 10 inches along the main course of the stream. At Prineville the mean annual rainfall is 9 inches; at Warm Springs, 11 inches; at Bend, 15 inches. On the headwaters of Crooked River the precipitation is probably 20 inches or more.

Although the winter temperatures are low, ice does not affect the determination of stream flow to any extent. This is due to the fact that the waters reach the river in the form of springs. The high stages usually occur in July as the result of the melting of snows in the mountains, although occasionally floods are caused by chinook winds in the early spring or late fall.

It has been estimated that Deschutes River alone from Bend to the mouth, a distance of 140 miles, is capable of furnishing over a million horsepower. Power plants need fear neither shortage of water during the summer months nor damage from flood. During the low-water period, throughout the lower 130 miles of the river's

course, it flows in a narrow canyon with an average fall of about 20 feet to the mile, and conditions are such that a succession of dams could be built almost through its entire length. (See Pl. VIII.)

DESCHUTES RIVER AT ALLEN'S RANCH, NEAR LAVA, OREG.[1]

This station was established February 17, 1905, on C. B. Allen's ranch, about 1 mile north of Lava, Oreg., in the SW. ¼ SW. ¼ sec. 8, T. 20 S., R. 11 E. It is half a mile above the mouth of the West Fork of Deschutes River. The data obtained here are particularly valuable in connection with irrigation development.

The inclined staff gage is on the east bank of the river, about 50 feet above the cable from which discharge measurements are made. The gage datum has not been changed, but the records are not as accurate as they should be, owing to a troublesome growth of weeds that appears in the river in the vicinity of the station during the summer months. As the season advances these weeds greatly retard the flow and cause backwater at the gage. Ice is likely to somewhat affect the discharge during December, January, and February.

The following discharge measurement was made by R. B. Post:

April 22, 1909: Width, 69 feet; area, 227 square feet; gage height, 7.08 feet; discharge, 432 second-feet.

Daily gage height, in feet, of Deschutes River at Allen's ranch, near Lava, Oreg., for 1909.

[Mrs. C. B. Allen, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.75	6.85	6.15	6.0	7.25	7.1	6.55	5.9	5.55	5.5	5.65	9.32
2	5.75	6.9	6.2	6.05	7.3	7.15	6.6	5.9	5.65	5.5	5.7	9.2
3	5.8	7.15	6.3	6.1	7.3	7.15	6.55	5.85	5.75	5.5	5.75	9.0
4	5.9	7.2	6.2	6.3	7.3	7.1	6.55	5.85	5.75	5.5	5.85	8.7
5	6.0	7.2	6.15	6.35	7.25	7.15	6.5	5.85	5.75	5.55	5.8	8.5
6	6.1	7.1	6.05	6.2	7.25	7.25	6.5	5.8	5.7	5.55	5.75	8.3
7	6.2	6.9	6.0	6.1	7.25	7.35	6.55	5.8	5.7	5.55	5.75	8.3
8	6.2	6.75	5.9	6.1	7.3	7.4	6.6	5.75	5.65	5.5	5.75	7.8
9	6.3	6.65	5.85	6.15	7.4	7.45	6.6	5.75	5.6	5.5	5.6	8.2
10	6.25	6.6	5.8	6.25	7.4	7.45	6.55	5.75	5.6	5.5	5.6	8.4
11	6.2	6.5	5.8	6.4	7.35	7.4	6.5	5.75	5.6	5.45	5.65	8.4
12	6.3	6.55	5.8	6.45	7.35	7.3	6.5	5.7	5.6	5.45	5.6	8.4
13	6.3	6.6	5.8	6.4	7.35	7.2	6.5	5.7	5.6	5.4	5.5	8.4
14	6.3	6.6	5.85	6.6	7.3	7.15	6.4	5.7	5.6	5.4	5.3	8.2
15	6.4	6.7	5.9	6.75	7.25	7.15	6.35	5.7	5.6	5.4	5.6	8.05
16	6.6	6.8	6.0	6.85	7.2	7.2	6.3	5.7	5.6	5.4	5.7	7.9
17	6.8	7.1	6.1	6.9	7.1	7.25	6.2	5.7	5.5	5.35	5.6	7.75
18	7.0	7.05	6.1	7.0	7.0	7.3	6.2	5.65	5.5	5.35	5.7	7.6
19	7.15	6.95	6.15	7.05	6.9	7.45	6.2	5.65	5.5	5.4	5.8	7.3
20	7.45	6.95	5.95	7.1	6.85	7.45	6.15	5.65	5.5	5.4	6.15	7.05
21	7.7	6.9	5.85	7.05	6.75	7.35	6.15	5.65	5.45	5.45	6.6	7.05
22	7.75	6.7	5.8	7.1	6.75	7.2	6.15	5.6	5.45	5.5	7.42	7.0
23	7.8	6.5	5.8	7.05	6.7	7.1	6.1	5.6	5.45	5.5	8.15	8.0
24	7.8	6.4	5.85	7.0	6.7	7.0	6.05	5.6	5.45	5.45	9.3	8.25
25	7.75	6.25	5.9	7.0	6.65	6.9	6.05	5.6	5.45	5.4	11.1	8.6
26	7.7	6.15	5.95	7.0	6.6	6.85	6.0	5.6	5.45	5.4	10.9	7.75
27	7.4	6.1	6.0	7.05	6.65	6.8	6.0	5.6	5.5	5.4	10.4	7.6
28	7.3	6.1	6.05	7.1	6.7	6.8	6.0	5.6	5.5	5.4	9.95	7.5
29	7.05	.....	6.1	7.1	6.8	6.75	5.95	5.55	5.5	5.4	9.75	7.4
30	6.9	.....	6.05	7.2	6.9	6.7	5.95	5.55	5.5	5.4	9.5	7.2
31	6.9	.....	6.0	.....	7.0	.....	5.95	5.55	.....	5.5	.....	7.05

NOTE.—The observer's ice notes are not complete for 1909. The river was probably frozen over Jan. 1 to about Feb. 19. Ice along edges Dec. 6; probably frozen over Dec. 21 to Dec. 26. On Dec. 24 and 25 there was an ice jam at the forks below. Ice gorge went out Dec. 26.

[1] The river at this point is locally known as "Little River."

A. BENHAM FALLS, 6 MILES ABOVE BEND.

B. CLINE FALLS, 19 MILES BELOW BEND

FALLS ON UPPER DESCHUTES RIVER, OREGON.

Daily discharge, in second-feet, of Deschutes River at Allen's ranch, near Lava, Oreg., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	222	205	513	468	317	188	141	135	154	1,310
2	242	214	528	483	329	188	154	135	160	1,260
3	262	223	528	483	317	180	166	135	166	1,170
4	242	262	528	468	317	180	166	135	180	1,050
5	232	272	513	483	305	180	166	141	173	970
6	214	242	513	513	305	173	160	141	166	890
7	205	223	513	544	317	173	160	141	166	890
8	188	223	528	559	329	166	154	135	166	694
9	180	232	559	575	329	166	147	135	147	850
10	173	252	559	575	317	166	147	135	147	930
11	173	283	544	559	305	166	147	130	154	930
12	173	294	544	528	305	160	147	130	147	930
13	173	283	544	498	305	160	147	125	135	930
14	180	329	528	483	283	160	147	125	115	850
15	188	368	513	483	272	160	147	125	147	790
16	205	396	498	498	262	160	147	125	160	732
17	223	410	468	513	242	160	135	120	147	676
18	223	439	439	528	242	154	135	120	160	624
19	232	454	410	575	242	154	135	125	173	528
20	196	468	396	575	232	154	135	125	232	454
21	180	454	368	544	232	154	130	130	329	454
22	173	468	368	498	232	147	130	135	565	439
23	173	454	355	468	223	147	130	135	830	476
24	180	439	355	439	214	147	130	130	1,300	513
25	188	439	342	410	214	147	130	125	2,150	550
26	196	439	329	396	205	147	130	125	2,050	587
27	205	454	342	382	205	147	135	125	1,800	624
28	214	468	355	382	205	147	135	125	1,580	591
29	223	468	382	368	196	141	135	125	1,490	559
30	214	498	410	355	196	141	135	125	1,380	498
31	205	.....	439	.....	196	141	.....	135	.....	454

NOTE.—These discharges were obtained from a rating curve which is well defined between 200 and 600 second-feet. Discharges Dec. 23 to 26 interpolated on account of ice conditions.

Monthly discharge of Deschutes River at Allen's ranch, near Lava, Oreg., for 1909.

[Drainage area, 720 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	.....	.....	150	0.208	0.24	9,220	D.
February	.....	.....	200	.278	.29	11,100	D.
March	262	173	203	.282	.33	12,500	C.
April	498	205	355	.493	.55	21,100	C.
May	559	329	458	.636	.73	28,200	C.
June	575	355	488	.678	.76	29,000	C.
July	329	196	264	.367	.42	16,200	C.
August	188	141	160	.222	.26	9,840	C.
September	166	130	143	.199	.22	8,510	C.
October	141	120	130	.181	.21	7,990	C.
November	2,150	115	556	.772	.86	33,100	C.
December	1,310	439	748	1.04	1.20	46,000	C.
The year	2,150	115	322	.447	6.07	233,000	

NOTE.—Means for January and February estimated, based on a comparison with climatological data.

DESCHUTES RIVER AT WEST'S RANCH, NEAR LAVA, OREG.

This station was established June 20, 1906, at a private bridge on B. F. West's ranch, about 2 miles north of Lava, Oreg., and 18 miles above Bend, Oreg. It is just below the mouth of Spring River and about 1½ miles below the mouth of West Fork of Deschutes River.

This station affords exceptionally favorable conditions and the results are above the average in accuracy. It is located above all present diversions from the stream and furnishes the requisite data for determining the quantity of water available for irrigation of lands in the Deschutes Valley. At present two large canals are operated under the provisions of the Carey Act by the Deschutes Irrigation & Power Co. The complete reclamation of all land segregated under this law contiguous to Deschutes River will bring the total to 360,000 acres under irrigation.

The staff gage first used at this station was spiked to the right approach of the bridge. A new vertical staff gage was set April 10, 1907, in the same section but 2 feet riverward at the same datum. The datum of these gages has not been changed since the station was established. Discharge measurements are made from the bridge.

The river at this point never freezes, as it is entirely spring fed, and although it is used for logging its channel is deep and the current swift and gage heights are not affected. On February 20, 1909, the observer moved away and the records will be interrupted until another can be secured. The interval can, however, be filled from the Benham Falls station.

Discharge measurements of Deschutes River at West's ranch, near Lava, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 2	R. B. Post	108	562	8.92	1,440
Apr. 23	do	114	615	9.43	1,780

Daily gage height, in feet, of Deschutes River at West's ranch, near Lava, Oreg., for 1909.

[B. F. West, observer.]

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1	8.9	9.1	11	8.7	9.0	21	9.5	.....
2	8.9	9.1	12	8.88	9.0	22	9.5	.....
3	8.9	9.2	13	8.95	9.0	23	9.45	.....
4	8.95	9.2	14	9.0	9.0	24	9.4	.....
5	8.95	9.15	15	9.0	9.0	25	9.4	.....
6	8.85	9.1	16	9.0	9.1	26	9.35	.....
7	8.95	9.1	17	9.02	9.25	27	9.35	.....
8	9.0	9.05	18	9.7	9.25	28	9.25	.....
9	8.95	9.05	19	9.75	9.25	29	9.2	.....
10	8.8	9.0	20	9.3	9.25	30	9.2	.....
						31	9.1	.....

NOTE.—For daily discharge at this station see station at Benham Falls, Jan. 1 to Feb. 20.

Daily discharge, in second-feet, of Deschutes River at West's ranch, near Lava, Oreg., for 1909.

Day.	Jan.	Feb.	Day.	Jan.	Feb.	Day.	Jan.	Feb.
1	1,430	1,610	11	1,280	1,520	21	2,010	.....
2	1,430	1,610	12	1,410	1,520	22	2,010	.....
3	1,430	1,700	13	1,480	1,520	23	1,960	.....
4	1,480	1,700	14	1,520	1,520	24	1,900	.....
5	1,480	1,660	15	1,520	1,520	25	1,900	.....
6	1,390	1,610	16	1,520	1,610	26	1,850	.....
7	1,480	1,610	17	1,540	1,750	27	1,850	.....
8	1,520	1,560	18	2,230	1,750	28	1,750	.....
9	1,480	1,560	19	2,280	1,750	29	1,700	.....
10	1,350	1,520	20	1,800	1,750	30	1,700	.....
						31	1,610	.....

NOTE.—These discharges are based on a rating curve that is well defined between discharges of 1,350 and 2,120 second-feet.

Monthly discharge of Deschutes River at West's ranch, near Lava, Oreg., for 1909.

[Drainage area, 1,240 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	2,280	1,280	1,650	1.33	1.53	101,000	A.
February (1-20)	1,750	1,520	1,620	1.31	.97	64,300	A.

DESCHUTES RIVER AT BENHAM FALLS, OREG.

This station, which is located 700 feet above Benham Falls, about 14 miles above Bend, Oreg., and above the intake of an irrigation canal under construction at this point, was established April 1, 1909, and is maintained in cooperation with the Deschutes Irrigation & Power Co.

On July 29, 1909, a cable was installed for making discharge measurements and a staff gage placed on the right bank near the cable. Better conditions were found at this point than obtained at the section of the lower gage installed by the Deschutes Irrigation & Power Co., which reads 3.35 feet lower than the United States Geological Survey gage.

The banks of the stream in the vicinity of the cable are low, but are not subject to overflow. The channel is straight and the bed of the stream is of sand and gravel. Weeds grow along each bank and may interfere somewhat with the determination of discharge in the summer months.

The results at this station are comparable with those formerly obtained at West's ranch, about 4 miles upstream from this point.

The following discharge measurement was made by R. B. Post:

July 30, 1909: Width, 137 feet; area, 969 square feet; gage height, 4 feet; discharge, 1,560 second-feet.

Daily gage height, in feet, of Deschutes River at Benham Falls, Oreg., for 1909.

[Deschutes Irrigation & Power Co., observers.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	4.05	4.35	4.35	4.15	4.00	3.92	3.95	3.95	5.40
2	.....	4.07	4.35	4.35	4.15	4.00	4.00	3.90	3.95	5.20
3	.....	4.15	4.40	4.35	.....	4.00	4.00	3.90	3.93	5.10
4	.....	4.20	4.40	4.35	.....	4.00	4.00	3.90	3.95	4.70
5	.....	4.20	4.40	4.35	4.20	3.90	.....	3.90	3.95	4.40
6	.....	4.13	4.40	4.35	4.15	3.99	3.98	3.90	3.95	3.95
7	.....	4.09	4.40	4.40	4.15	3.99	3.98	3.90	.....	4.35
8	.....	4.05	4.40	4.40	4.15	.....	3.98	3.90	3.95	4.65
9	.....	4.07	4.40	4.45	4.15	3.99	3.95	3.90	3.95	4.90
10	.....	4.15	4.40	4.45	4.15	3.99	3.95	.....	3.95	4.90
11	.....	4.15	4.45	4.45	.....	3.97	3.95	3.90	3.95	4.80
12	.....	4.17	4.45	4.45	4.10	3.96	.....	3.90	3.90	4.80
13	.....	4.20	4.45	4.40	4.05	3.96	3.95	3.85	3.90	4.80
14	.....	4.25	4.45	4.35	4.05	3.96	3.95	3.85	3.85	4.80
15	.....	4.27	4.40	4.35	4.05	.....	3.95	3.85	3.80	4.60
16	.....	4.30	4.35	4.35	4.05	3.97	3.90	3.85	3.75	4.50
17	.....	4.30	4.35	4.35	4.05	3.95	3.90	.....	3.85	4.40
18	.....	4.30	4.30	4.40	.....	3.95	3.90	3.85	3.85	4.40
19	.....	4.35	4.25	4.40	3.95	3.95	3.90	3.85	3.95	4.30
20	.....	4.35	4.25	4.40	4.00	3.95	3.90	3.85	4.10	4.30
21	.....	4.35	4.25	4.35	4.05	3.95	3.90	3.85	4.30	4.30
22	.....	4.35	4.25	4.35	4.00	.....	3.90	3.85	4.60	4.30
23	.....	4.35	4.25	4.30	4.00	3.95	3.90	3.90	4.90	4.30
24	.....	4.30	4.20	4.25	4.00	3.95	3.90	3.90	5.40	4.30
25	.....	4.30	4.30	4.25	.....	3.94	3.90	3.90	.....	.....
26	.....	4.30	4.20	4.25	4.00	3.94	.....	3.90	.....	.....
27	.....	4.33	4.20	4.20	4.00	3.93	3.95	3.85	.....	4.30
28	.....	4.35	4.25	4.20	4.00	3.93	3.95	3.85	.....	4.30
29	.....	4.35	4.30	4.20	4.00	.....	3.95	3.80	5.40	4.20
30	4.05	4.35	4.30	4.20	4.00	3.93	3.95	3.80	6.00	4.20
31	4.05	.....	4.30	.....	3.96	3.92	.....	3.80	.....	4.20

NOTE.—Gage heights Mar. 30 to July 31 are from the Deschutes Irrigation & Power Co.'s gage and have been reduced to the datum of the United States Geological Survey gage by adding 3.35 feet.

Daily discharge, in second-feet, of Deschutes River at Benham Falls, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,430	1,610	1,430	1,590	1,800	1,800	1,600	1,500	1,510	1,530	1,530	2,610
2	1,430	1,610	1,500	1,610	1,800	1,800	1,600	1,500	1,500	1,500	1,530	2,450
3	1,430	1,700	1,550	1,660	1,840	1,800	1,670	1,500	1,500	1,500	1,510	2,370
4	1,480	1,700	1,550	1,690	1,840	1,800	1,680	1,500	1,500	1,500	1,530	2,060
5	1,480	1,660	1,530	1,690	1,840	1,800	1,690	1,550	1,500	1,500	1,530	1,840
6	1,390	1,610	1,500	1,640	1,840	1,800	1,660	1,550	1,550	1,500	1,530	1,530
7	1,480	1,610	1,480	1,620	1,840	1,840	1,660	1,550	1,550	1,500	1,530	1,800
8	1,520	1,560	1,420	1,590	1,840	1,840	1,660	1,550	1,550	1,500	1,530	2,020
9	1,480	1,560	1,420	1,610	1,840	1,870	1,660	1,550	1,530	1,500	1,530	2,210
10	1,350	1,520	1,390	1,660	1,840	1,870	1,660	1,550	1,530	1,500	1,530	2,210
11	1,280	1,520	1,390	1,660	1,870	1,870	1,640	1,540	1,530	1,500	1,530	2,140
12	1,410	1,520	1,390	1,670	1,870	1,870	1,620	1,530	1,530	1,500	1,500	2,140
13	1,480	1,520	1,380	1,690	1,870	1,840	1,590	1,530	1,530	1,460	1,500	2,140
14	1,520	1,520	1,390	1,720	1,870	1,800	1,590	1,530	1,530	1,460	1,460	2,140
15	1,520	1,520	1,390	1,740	1,840	1,800	1,590	1,540	1,530	1,460	1,430	1,980
16	1,520	1,610	1,440	1,760	1,800	1,800	1,590	1,540	1,500	1,460	1,400	1,910
17	1,540	1,750	1,440	1,760	1,800	1,800	1,590	1,530	1,500	1,460	1,460	1,840
18	2,230	1,750	1,460	1,760	1,760	1,840	1,560	1,530	1,500	1,460	1,460	1,840
19	2,280	1,750	1,460	1,800	1,720	1,840	1,530	1,530	1,500	1,460	1,530	1,760
20	1,800	1,750	1,440	1,800	1,720	1,840	1,560	1,530	1,500	1,460	1,620	1,760

Daily discharge, in second-feet, of Deschutes River at Benham Falls, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	2,010	1,720	1,440	1,800	1,720	1,800	1,590	1,530	1,500	1,460	1,760	1,760
22	2,010	1,620	1,430	1,800	1,720	1,800	1,530	1,530	1,500	1,460	1,980	1,760
23	1,960	1,550	1,440	1,800	1,720	1,760	1,560	1,530	1,500	1,500	2,210	1,760
24	1,900	1,550	1,430	1,760	1,690	1,720	1,560	1,530	1,500	1,500	2,610	1,760
25	1,900	1,500	1,440	1,760	1,760	1,720	1,560	1,520	1,500	1,500	3,010	1,760
26	1,850	1,440	1,420	1,760	1,690	1,720	1,560	1,520	1,520	1,500	4,510	1,760
27	1,850	1,440	1,390	1,780	1,690	1,690	1,560	1,510	1,530	1,460	4,760	1,760
28	1,750	1,430	1,420	1,800	1,720	1,690	1,560	1,510	1,530	1,460	4,200	1,760
29	1,700	.....	1,420	1,800	1,760	1,690	1,560	1,510	1,530	1,430	2,610	1,690
30	1,700	.....	1,590	1,860	1,760	1,690	1,560	1,510	1,530	1,430	3,120	1,690
31	1,610	.....	1,590	.....	1,760	.....	1,530	1,510	.....	1,430	.....	1,690

NOTE.—The discharges Mar. 30 to Dec. 31 were obtained from a rating curve that is not well defined. Discharges at West's ranch used Jan. 1 to Feb. 20; discharges at Bend used Feb. 21 to Mar. 29. Discharge interpolated for days when gage was not read. The daily discharges Jan. 1 to Mar. 29 can not be considered quite so reliable as those obtained at this section.

Monthly discharge of Deschutes River at Benham Falls, Oreg., for 1909.

[Drainage area, 1,430 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	2,280	1,280	1,650	1.11	1.28	101,000	.....
February	1,750	1,430	1,530	1.07	1.11	88,300	.....
March	1,590	1,380	1,250	.98	1.13	89,200	.....
April	1,800	1,590	1,720	1.16	1.29	102,000	C.
May	1,870	1,690	1,790	1.21	1.40	110,000	C.
June	1,870	1,690	1,790	1.21	1.35	107,000	C.
July	1,690	1,530	1,600	1.08	1.24	98,400	C.
August	1,560	1,510	1,530	1.03	1.18	94,100	C.
September	1,560	1,500	1,520	1.03	1.15	90,400	C.
October	1,530	1,430	1,480	1.00	1.15	91,000	C.
November	4,760	1,400	2,040	1.38	1.54	121,000	C.
December	2,610	1,530	1,930	1.30	1.50	119,000	C.
The period	4,760	1,280	1,670	1.13	15.32	1,210,000	

NOTE.—Discharges at West's ranch used Jan. 1 to Feb. 20; discharges at Bend used Feb. 21 to Mar. 29. Owing to the method of determining the monthly estimates for January, February, and March, the means for these months can not be considered as accurate as the following months.

DESCHUTES RIVER AT BEND, OREG.

A station was established at Sizemore's bridge, near Bend, December 22, 1904, and data were published for 1905 and 1906, but the conditions were not favorable for accurate results, as the channel at this point is comparatively shallow and exceedingly rough and the gage heights are influenced by back water from saw logs impounded at a mill below the station, and the data for these years are therefore not reliable.

On March 30, 1907, gage records were suspended at this point and on April 23, 1907, the station was reestablished at Statt's bridge, in Bend, Oreg. A gage was bolted to a bowlder near the pumping plant.

The gage heights at this location are not artificially influenced, but there are no facilities for making accurate measurements. The records of gage heights are furnished without cost to the Survey by Mr. C. A. Stanborough, engineer of the city pumping plant. As the discharge of the river at this point is of general interest in the study of the river system, a rating has been developed by comparison with stations on the river and canals above.

The following discharge measurement was made by R. B. Post:

December 18, 1909: Width, 99 feet; area, 789 square feet; gage height, 1.89 feet; discharge, 2,010 second-feet.

Daily gage height, in feet, of Deschutes River at Bend, Oreg., for 1909.

[C. A. Stanborough, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.40	1.50	1.39	1.38	1.55	1.40	1.18	1.18	1.05	1.15	1.34	2.70
2	1.40	1.45	1.45	1.40	1.55	1.39	1.15	1.14	1.10	1.18	1.42	2.60
3	1.41	1.55	1.50	1.45	1.50	1.49	1.15	1.10	1.14	1.19	1.50	2.50
4	1.41	1.60	1.50	1.50	1.50	1.52	1.12	1.10	1.15	1.20	1.50	2.40
5	1.48	1.60	1.48	1.50	1.50	1.58	1.12	1.06	1.18	1.20	1.50	.....
6	1.44	1.49	1.45	1.46	1.45	1.42	1.10	1.02	1.16	1.22	1.50	.....
7	1.42	1.49	1.44	1.40	1.50	1.45	1.15	1.01	1.15	1.20	1.45	.....
8	1.52	1.50	1.38	1.40	1.45	1.45	1.18	1.00	1.15	1.20	1.45	.....
9	1.40	1.50	1.38	1.40	1.50	1.44	1.16	.96	1.12	1.20	1.50	.....
10	1.22	1.50	1.35	1.41	1.50	1.44	1.16	.95	1.10	1.20	1.50	.....
11	1.12	1.49	1.35	1.45	1.50	1.39	1.16	.98	1.10	1.19	1.50	.....
12	1.10	1.42	1.35	1.45	1.50	1.39	1.15	.95	1.10	1.19	1.42	.....
13	1.35	1.41	1.34	1.45	1.50	1.36	1.15	.95	1.12	1.19	1.39	.....
14	1.40	1.38	1.35	1.48	1.49	1.36	1.12	.99	1.10	1.19	1.35	.....
15	1.50	1.36	1.35	1.45	1.45	1.34	1.09	.98	1.10	1.18	1.38	.....
16	1.50	1.44	1.40	1.50	1.41	1.36	1.09	.98	1.10	1.15	1.30	.....
17	1.52	1.58	1.40	1.50	1.39	1.42	1.02	.98	1.10	1.18	1.36	.....
18	1.55	1.58	1.42	1.50	1.35	1.40	1.04	.98	1.10	1.16	1.29	.....
19	1.60	1.58	1.42	1.45	1.31	1.43	1.55	.98	1.10	1.19	1.32	.....
20	1.68	1.65	1.40	1.50	1.31	1.41	1.55	.95	1.10	1.20	1.44	2.00
21	1.80	1.65	1.40	1.50	1.30	1.44	1.55	.96	1.10	1.19	1.59	.....
22	1.74	1.56	1.40	1.50	1.30	1.39	1.55	.94	1.10	1.20	1.92	.....
23	1.72	1.50	1.40	1.50	1.29	1.36	1.55	.95	1.10	1.20	2.15	.....
24	1.72	1.50	1.40	1.50	1.30	1.32	1.53	.96	1.10	1.20	2.24	.....
25	1.70	1.45	1.40	1.50	1.30	1.29	1.53	.95	1.11	1.18	2.52	.....
26	1.70	1.40	1.38	1.45	1.29	1.28	1.52	.99	1.12	1.16	3.30	.....
27	1.65	1.40	1.35	1.45	1.25	1.24	1.52	1.00	1.10	1.15	3.42	1.70
28	1.60	1.39	1.38	1.50	1.29	1.22	1.52	1.08	1.14	1.15	3.25	1.65
29	1.50	.....	1.38	1.52	1.30	1.21	1.52	1.06	1.19	1.18	3.00	1.65
30	1.55	.....	1.40	1.52	1.35	1.22	1.36	1.05	1.16	1.30	2.85	1.66
31	1.55	.....	1.40	.....	1.35	.....	1.26	1.03	.....	1.30	.....	1.68

Daily discharge, in second-feet, of Deschutes River at Bend, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,440	1,550	1,430	1,420	1,600	1,440	1,230	1,230	1,120	1,200	1,380	3,330
2	1,440	1,500	1,500	1,440	1,600	1,430	1,200	1,200	1,160	1,230	1,460	3,150
3	1,450	1,600	1,550	1,500	1,550	1,540	1,200	1,160	1,200	1,240	1,550	2,970
4	1,450	1,660	1,550	1,550	1,550	1,570	1,180	1,160	1,200	1,250	1,550	2,800
5	1,530	1,660	1,530	1,550	1,550	1,640	1,180	1,130	1,230	1,250	1,550	2,120
6	1,480	1,540	1,500	1,510	1,500	1,460	1,160	1,100	1,210	1,270	1,550	2,040
7	1,460	1,540	1,480	1,440	1,550	1,500	1,200	1,090	1,200	1,250	1,500	1,980
8	1,570	1,550	1,420	1,440	1,500	1,500	1,230	1,080	1,200	1,250	1,500	1,930
9	1,440	1,550	1,420	1,440	1,550	1,480	1,210	1,050	1,180	1,250	1,550	1,900
10	1,270	1,550	1,390	1,450	1,550	1,480	1,210	1,040	1,160	1,250	1,550	1,840

Daily discharge, in second-feet, of Deschutes River at Bend, Oreg., for 1909—Continued

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1,180	1,540	1,390	1,500	1,550	1,430	1,210	1,070	1,160	1,240	1,550	1,910
12	1,160	1,460	1,390	1,500	1,550	1,430	1,200	1,040	1,160	1,240	1,460	1,960
13	1,390	1,450	1,380	1,500	1,550	1,400	1,200	1,040	1,180	1,240	1,430	1,980
14	1,440	1,420	1,390	1,530	1,540	1,400	1,180	1,070	1,160	1,240	1,390	2,080
15	1,550	1,400	1,390	1,500	1,500	1,380	1,150	1,070	1,160	1,230	1,420	2,180
16	1,550	1,480	1,440	1,550	1,450	1,400	1,150	1,070	1,160	1,200	1,340	2,550
17	1,570	1,640	1,440	1,550	1,430	1,460	1,100	1,070	1,160	1,230	1,400	2,220
18	1,600	1,640	1,460	1,550	1,390	1,440	1,110	1,070	1,160	1,210	1,330	2,060
19	1,660	1,640	1,460	1,500	1,350	1,470	1,600	1,070	1,160	1,240	1,360	2,030
20	1,760	1,720	1,440	1,550	1,350	1,450	1,600	1,040	1,160	1,250	1,480	2,170
21	1,900	1,720	1,440	1,550	1,340	1,480	1,600	1,050	1,160	1,240	1,650	1,980
22	1,830	1,620	1,440	1,550	1,340	1,430	1,600	1,040	1,160	1,250	2,060	1,930
23	1,800	1,550	1,440	1,550	1,330	1,400	1,600	1,040	1,160	1,250	2,400	1,880
24	1,800	1,550	1,440	1,550	1,340	1,360	1,580	1,050	1,160	1,250	2,530	1,980
25	1,780	1,500	1,440	1,550	1,340	1,330	1,580	1,040	1,170	1,230	3,010	1,910
26	1,780	1,440	1,420	1,500	1,330	1,320	1,580	1,070	1,180	1,210	4,510	1,850
27	1,720	1,440	1,390	1,500	1,300	1,290	1,570	1,080	1,160	1,200	4,760	1,780
28	1,660	1,430	1,420	1,550	1,330	1,270	1,570	1,140	1,200	1,200	4,400	1,720
29	1,550	.....	1,420	1,570	1,340	1,260	1,570	1,130	1,240	1,230	3,900	1,720
30	1,600	.....	1,440	1,570	1,390	1,270	1,400	1,120	1,210	1,340	3,620	1,730
31	1,600	.....	1,440	.....	1,390	.....	1,300	1,100	.....	1,340	.....	1,760

NOTE.—These discharges were obtained from a rating curve which is based on one measurement and comparison with discharges at Benham Falls during periods of approximately constant flow, considering diversions. Discharges Dec. 5, to 19 taken the same as those at Laidlaw; Dec. 21 to 26 estimated.

Monthly discharge of Deschutes River at Bend, Oreg., for 1909.

[Drainage area, 1,530 square miles.]

Month.	Discharge in second-feet.				Run-off.	
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.
January	1,900	1,160	1,560	1.02	1.18	95,900
February	1,720	1,400	1,550	1.01	1.05	86,100
March	1,550	1,380	1,440	.941	1.08	88,500
April	1,570	1,420	1,510	.987	1.10	89,800
May	1,600	1,300	1,450	.948	1.09	89,200
June	1,640	1,260	1,420	.928	1.04	84,500
July	1,600	1,100	1,340	.876	1.01	82,400
August	1,230	1,040	1,090	.712	.82	67,000
September	1,240	1,120	1,180	.771	.86	70,200
October	1,340	1,200	1,240	.810	.93	76,200
November	4,760	1,330	2,070	1.35	1.51	123,000
December	3,330	1,720	2,110	1.38	1.59	130,000
The year	4,760	1,040	1,500	.978	13.26	1,080,000

NOTE.—Discharges at Laidlaw used Dec. 5 to 19; Dec. 21 to 26 estimated. Owing to the approximations involved in determining these estimates the accuracy of the monthly means can not be considered better than fair.

DESCHUTES RIVER AT LAIDLAW, OREG.

This station was established January 1, 1909, at the old Laidlaw highway bridge in Laidlaw, Oreg. It is below all important diversions for irrigation. A short distance below the station the river enters a canyon which it follows to its mouth.

The vertical staff gage is attached to piling on the highway bridge. Discharge measurements are made from the new county bridge 1 mile upstream from the gage. As no observer was available

at the upper bridge location, it was found necessary to locate the gage at the lower bridge, where measuring conditions are not good. At the measuring section the right bank is low, but is not liable to overflow. The left bank is high and rocky, more or less covered with brush and willows. The bed of the stream is composed of gravel and is fairly permanent.

Below Laidlaw the stream is essentially a power stream, and above the conditions are favorable for diversion of water into irrigation canals.

Discharge measurements of Deschutes River at Laidlaw, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 1	R. B. Post	148	397	0.57	1,380
Apr. 20	do	155	410	.68	1,520
July 31	do	143	363	.43	1,200
Oct. 14	do	143	378	.41	1,160
Dec. 20	do	154	514	.89	1,930

Daily gage height, in feet, of Deschutes River at Laidlaw, Oreg., for 1909.

[Wm. P. Thorp, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.57	0.65			0.70	0.63	0.45	0.41	0.27	0.41		3.07
2	.57	.68			.70	.74	.40	.39	.26	.39	0.65	
3	.57	.70			.72	.96	.37			.39	.66	
4	.57	.72		0.68	.68	.80	.38	.37	.26	.43	.65	1.80
5	.58	.71		.68	.67	.80	.40			.43	.67	1.02
6	.58	.70		.64	.68	.82	.41			.46	.68	.97
7				.60	.69	.80	.35			.45	.67	.93
8				.60	.67	.80	.38			.44	.73	.89
9				.58	.68	.68	.37	.21		.43	.71	.87
10				.60	.69	.68	.39	.20		.43	.71	.83
11				.64	.66	.71	.37	.18		.42	.69	.88
12				.62	.67	.66	.40			.43	.68	.91
13				.64	.65	.67	.38			.42	.68	.93
14		.69		.66	.64	.68		.19			.70	.99
15	.59	.69		.67	.60	.65	.29	.17			.67	1.06
16	.60	.69		.67	.62	.63	.29	.18			.73	1.30
17	.70	.73		.68	.59	.64	.27			.48	.71	1.09
18	.80	.75		.67	.54	.63		.18	.38	.50	.64	.98
19	.90	.73		.69	.55	.64	.68	.19	.37	.46	.65	.96
20	.90	.73		.69	.53	.65	.65	.21	.39	.46	.67	
21	1.00			.69	.49	.62	.65	.21	.38	.45	1.76	.93
22	.92			.67	.48	.60	.63		.38	.42	1.77	
23	.92			.64	.49	.59	.64	.24	.37	.43		.86
24	.90			.64	.49	.57		.23	.36	.43	1.95	.93
25	.80			.65	.51	.52	.63	.26	.38	.42	2.77	.96
26	.80			.66	.53	.54	.64	.27	.38	.45	3.00	1.09
27	.75			.68	.54	.49		.28	.42	.47	3.11	
28	.70			.68	.54	.50	.61		.42	.49	3.09	
29	.68			.69	.53	.49	.62		.41	.49	3.03	
30	.68			.68	.61	.48	.57		.42	.51	2.89	
31	.68				.64		.48			.52		

Daily discharge, in second-feet, of Deschutes River at Laidlaw, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,380	1,480	1,420	1,410	1,550	1,460	1,220	1,170	1,010	1,170	1,400	4,780
2	1,380	1,520	1,440	1,410	1,550	1,600	1,160	1,150	996	1,150	1,480	4,320
3	1,380	1,550	1,480	1,480	1,580	1,900	1,120	1,140	996	1,150	1,500	3,850
4	1,380	1,580	1,530	1,520	1,520	1,680	1,140	1,120	996	1,200	1,480	3,390
5	1,390	1,560	1,480	1,520	1,510	1,680	1,160	1,080	1,010	1,200	1,510	2,120
6	1,390	1,550	1,460	1,470	1,520	1,710	1,170	1,050	1,020	1,240	1,520	2,040
7	1,380	1,540	1,420	1,420	1,540	1,680	1,100	1,010	1,030	1,220	1,510	1,980
8	1,470	1,530	1,410	1,420	1,510	1,680	1,140	970	1,040	1,210	1,590	1,930
9	1,320	1,530	1,410	1,390	1,520	1,520	1,120	941	1,050	1,200	1,560	1,900
10	1,240	1,490	1,380	1,420	1,540	1,520	1,150	930	1,060	1,200	1,560	1,840
11	1,180	1,450	1,380	1,470	1,500	1,560	1,120	910	1,070	1,190	1,540	1,910
12	1,160	1,450	1,370	1,450	1,510	1,500	1,160	910	1,080	1,200	1,520	1,960
13	1,210	1,450	1,370	1,470	1,480	1,510	1,140	920	1,060	1,190	1,520	1,980
14	1,280	1,540	1,380	1,500	1,470	1,520	1,080	920	1,100	1,210	1,550	2,080
15	1,410	1,540	1,380	1,510	1,420	1,480	1,030	900	1,110	1,220	1,510	2,180
16	1,420	1,540	1,400	1,510	1,450	1,460	1,030	910	1,120	1,240	1,590	2,550
17	1,550	1,590	1,420	1,520	1,410	1,470	1,010	910	1,130	1,260	1,560	2,220
18	1,680	1,620	1,440	1,510	1,340	1,460	1,010	910	1,140	1,230	1,470	2,060
19	1,820	1,590	1,440	1,540	1,360	1,470	1,520	920	1,120	1,240	1,480	2,030
20	1,820	1,590	1,420	1,540	1,330	1,480	1,480	941	1,150	1,240	1,510	2,000
21	1,960	1,590	1,430	1,540	1,280	1,450	1,480	941	1,140	1,220	3,180	1,980
22	1,850	1,550	1,430	1,510	1,260	1,420	1,460	960	1,140	1,190	3,200	1,930
23	1,850	1,530	1,430	1,470	1,280	1,410	1,470	974	1,120	1,200	3,360	1,880
24	1,820	1,530	1,420	1,470	1,280	1,380	1,460	963	1,110	1,200	3,510	1,980
25	1,680	1,450	1,410	1,480	1,300	1,320	1,460	996	1,140	1,190	5,010	2,030
26	1,680	1,410	1,400	1,500	1,330	1,340	1,470	1,010	1,140	1,220	5,450	2,220
27	1,620	1,410	1,380	1,520	1,340	1,280	1,450	1,020	1,190	1,250	5,660	1,700
28	1,550	1,410	1,390	1,520	1,340	1,230	1,430	1,020	1,190	1,280	5,620	1,700
29	1,520	.....	1,410	1,540	1,330	1,280	1,450	1,020	1,170	1,280	5,510	1,700
30	1,520	.....	1,420	1,520	1,430	1,260	1,380	1,010	1,190	1,300	5,240	1,700
31	1,520	.....	1,410	.....	1,470	.....	1,260	1,010	.....	1,320	.....	1,700

NOTE.—Discharges Jan. 1 to Nov. 30 were obtained from a rating curve which is not well defined; Dec. 4 to 26 from a curve which is well defined between 1,400 and 2,090 second-feet. Discharges for days for which there are no gage heights were estimated from a hydrograph comparison with the flow at Bend except for Dec. 1 to 3, which were interpolated.

Monthly discharge of Deschutes River at Laidlaw, Oreg., for 1909.

[Drainage area, 1,880 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	1,960	1,160	1,510	0.803	0.93	92,800	C.
February	1,620	1,410	1,520	.809	.84	84,400	D.
March	1,530	1,370	1,420	.755	.87	87,300	D.
April	1,540	1,390	1,480	.787	.88	88,100	A.
May	1,580	1,260	1,430	.761	.88	87,900	A.
June	1,900	1,260	1,490	.793	.88	88,700	A.
July	1,520	1,010	1,250	.665	.77	76,900	A.
August	1,170	900	988	.526	.61	60,800	B.
September	1,190	996	1,090	.580	.65	64,900	C.
October	1,320	1,150	1,220	.649	.75	75,000	A.
November	5,660	1,400	2,540	1.35	1.51	151,000	A.
December	4,780	1,700	2,250	1.20	1.38	138,000	B.
The year	5,660	900	1,520	.806	10.95	1,100,000	

DESCHUTES RIVER NEAR BIGGS, OREG.

This station was first established October 19, 1897, at the Free Bridge and known as "Deschutes River near Moro." It was discontinued December 31, 1899, and reestablished July 7, 1906, at

Taylor's ranch, near Biggs post office, Oreg., 1½ miles above the mouth of the river, about the same distance above the Oregon Railroad & Navigation Co.'s bridge, and about 1 mile above Moody's toll bridge. The river at this point runs in a deep canyon and there are no tributaries for several miles upstream. The water at this point is at present used only for an insignificant amount of irrigation. The records at this station are directly comparable with those obtained at the Free Bridge near Moro from 1897 to 1899, although conditions at the the earlier station are not nearly so favorable for accurate results as are those at the present location.

The staff gage is in two sections on the right bank, about 450 feet below the cable from which discharge measurements are made. The upper section of the gage is vertical and located near the inclined low-water section.

No discharge measurements were made during 1909. The station was last inspected October 10, 1908, and conditions of flow are believed to be unchanged. The accuracy of the daily and monthly discharges given below is dependent upon the permanency of conditions of flow and the elevations of the gage since that date.

Daily gage height, in feet, of Deschutes River near Biggs, Oreg., for 1909.

[Wilbur Taylor, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1					3.15	2.80	2.55	2.45			2.47	
2	2.50	2.70	3.10	3.30	3.12				2.30	2.45		3.47
3	2.50			3.35		2.95	2.53	2.43	2.38		2.68	
4		2.65	3.10	3.50	3.08	3.20				2.45		3.30
5				3.43		3.10		2.40	2.40		2.68	3.25
6		2.60	3.10		3.05	3.00				2.45	2.68	
7		2.63	3.10	3.30				2.40	2.40		2.68	3.20
8					3.00	2.95	2.42	2.40				
9		2.60	3.05	3.20					2.40	2.45	2.70	3.20
10					3.00	2.90	2.40	2.39		2.45		
11		2.58	3.03	3.10			2.40		2.40		2.70	3.20
12					3.00	2.88		2.38	2.40	2.45		3.40
13		2.55	3.00	3.15		2.87	2.40				2.70	4.20
14		2.55			3.00			2.38	2.40	2.45	2.70	
15			2.95	3.25	2.98	2.85	2.42	2.37				3.60
16		2.54		3.30	2.93				2.40	2.45	2.71	
17		2.90	2.90	3.40		2.83	2.45	2.37		2.45		3.20
18		4.00		3.35	2.85		2.46		2.40		2.73	3.20
19	4.20		2.88			2.80		2.35	2.40	2.47		3.20
20	4.50	3.60	2.87	3.25	2.80	2.78	2.48				2.90	
21	4.40	3.40	2.86					2.35	2.40	2.47	3.00	3.20
22				3.20	2.7	2.75	2.50	2.35			3.10	
23	3.70	3.20	2.84		2.7				2.40	2.47	6.10	3.20
24				3.15		2.65	2.52	2.30		2.47	6.70	
25	3.20	3.15	2.80	3.10	2.7		2.57		2.40		5.90	3.20
26						2.63		2.30	2.40	2.47		3.20
27	3.00	3.10	2.80	3.15	2.72	2.60	2.50				4.60	
28		3.10	3.01					2.30	2.45	2.47	4.20	3.20
29	2.90		3.50	3.25	2.73	2.58	2.48	2.30				
30	2.80		3.70	3.20	2.73				2.45	2.47	4.00	3.20
31	2.75		3.40				2.47	2.30				3.20

NOTE.—Ice reported along the shores from Jan. 4 to 18; slush ice was running during most of this period. Ice went out Jan. 19.

Daily discharge, in second-feet, of Deschutes River near Biggs, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5,700	6,470	7,900	8,920	8,100	6,750	5,850	5,550	5,150	5,550	5,610	10,700
2	5,700	6,380	7,900	8,700	7,980	7,030	5,820	5,520	5,150	5,550	5,960	9,460
3	5,700	6,280	7,900	8,920	7,900	7,310	5,790	5,490	5,350	5,550	6,300	9,080
4	5,700	6,190	7,900	9,600	7,820	8,300	5,720	5,440	5,380	5,550	6,300	8,700
5	5,700	6,100	7,900	9,280	7,760	7,900	5,660	5,400	5,400	5,550	6,300	8,500
6	5,700	6,000	7,900	8,990	7,700	7,500	5,590	5,400	5,400	5,550	6,300	8,400
7	5,700	6,110	7,900	8,700	7,600	7,400	5,530	5,400	5,400	5,550	6,300	8,300
8	5,700	6,060	7,800	8,500	7,500	7,310	5,460	5,400	5,400	5,550	6,340	8,300
9	5,700	6,000	7,700	8,300	7,500	7,220	5,430	5,390	5,400	5,550	6,380	8,300
10	5,700	5,970	7,660	8,100	7,500	7,120	5,400	5,380	5,400	5,550	6,380	8,300
11	5,700	5,940	7,620	7,900	7,500	7,080	5,400	5,360	5,400	5,550	6,380	8,300
12	5,700	5,900	7,560	8,000	7,500	7,050	5,400	5,350	5,400	5,550	6,380	9,150
13	5,700	5,850	7,500	8,100	7,500	7,010	5,400	5,350	5,400	5,550	6,380	13,000
14	5,700	5,850	7,400	8,300	7,500	6,980	5,430	5,350	5,400	5,550	6,380	11,500
15	5,700	5,840	7,310	8,500	7,420	6,940	5,460	5,320	5,400	5,550	6,400	10,000
16	5,700	5,820	7,220	8,700	7,240	6,900	5,500	5,320	5,400	5,550	6,410	9,150
17	7,000	7,120	7,120	9,150	7,090	6,860	5,550	5,320	5,400	5,550	6,450	8,300
18	10,000	12,000	7,080	8,920	6,940	6,800	5,580	5,310	5,400	5,580	6,490	8,300
19	13,000	11,000	7,050	8,710	6,840	6,750	5,610	5,300	5,400	5,610	6,800	8,300
20	14,500	10,000	7,010	8,500	6,750	6,680	5,640	5,290	5,400	5,610	7,120	8,300
21	14,000	9,150	6,980	8,400	6,560	6,620	5,670	5,280	5,400	5,610	7,500	8,300
22	12,200	8,720	6,940	8,300	6,380	6,560	5,700	5,280	5,400	5,610	7,900	8,300
23	10,500	8,300	6,900	8,200	6,380	6,380	5,730	5,220	5,400	5,610	22,800	8,300
24	9,400	8,200	6,820	8,100	6,380	6,190	5,760	5,150	5,400	5,610	26,000	8,300
25	8,300	8,100	6,750	7,900	6,380	6,150	5,910	5,150	5,400	5,610	21,600	8,300
26	7,900	8,000	6,750	8,000	6,420	6,110	5,800	5,150	5,400	5,610	18,300	8,300
27	7,500	7,900	6,750	8,100	6,450	6,000	5,700	5,150	5,480	5,610	15,000	8,300
28	7,310	7,900	7,540	8,300	6,470	5,970	5,670	5,150	5,550	5,610	13,000	8,300
29	7,120	.....	9,600	8,500	6,490	5,940	5,640	5,150	5,550	5,610	12,500	8,300
30	6,750	.....	10,500	8,300	6,490	5,900	5,620	5,150	5,550	5,610	12,000	8,300
31	6,560	.....	9,150	.....	6,620	.....	5,610	5,150	.....	5,610	.....	8,300

NOTE.—These discharges were obtained from a rating curve that is well defined below 7,500 second-feet. Discharge Jan. 3 to 18 estimated on account of ice conditions. Discharges interpolated for days when gage was not read.

Monthly discharge of Deschutes River near Biggs, Oreg., for 1909.

[Drainage area, 9,180 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	14,500	5,700	7,520	0.819	0.94	462,000	C.
February	12,000	5,820	7,260	.791	.82	403,000	A.
March	10,500	6,750	7,610	.829	.96	468,000	A.
April	9,600	7,900	8,500	.926	1.03	506,000	A.
May	8,100	6,380	7,120	.776	.89	438,000	A.
June	8,300	5,900	6,820	.743	.83	406,000	A.
July	5,910	5,400	5,610	.611	.70	345,000	A.
August	5,550	5,150	5,310	.578	.67	326,000	A.
September	5,550	5,150	5,400	.588	.66	321,000	A.
October	5,610	5,550	5,580	.608	.70	343,000	A.
November	26,000	5,610	9,470	1.03	1.15	564,000	A.
December	13,000	8,300	8,830	.962	1.11	543,000	B.
The year	26,000	5,150	7,090	.772	10.46	5,120,000	

WEST FORK OF DESCHUTES RIVER NEAR LAVA, OREG.[1]

This station was established February 26, 1905, on the ranch of Joseph Whitfield, in the NE. ¼ NE. ¼, sec. 24, T. 20 S., R. 10 E., 1½ miles west of Lava, Oreg., and about the same distance above the

[1] This river is locally known as Big River.

junction of West Fork with Deschutes River. It was discontinued March 31, 1907, and reestablished at the same place April 23, 1909. A discharge measurement was made, however, on March 28, 1908. See Water-Supply Paper 252, page 318.

The inclined staff gage is located on the right bank above the cable from which discharge measurements are made.

Ice affects the flow past the station during the winter to some extent. In the summer a growth of weeds in the river bed causes backwater conditions at the gage.

The station furnishes data of considerable economic value, as the waters of the stream will be largely used for irrigation. Some exceptional storage sites are found in the headwaters of the river.

Discharge measurements of West Fork of Deschutes River near Lava, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 3	R. B. Post	100	475	8.2	962
Apr. 23	do	100	493	8.41	962
Dec. 14	do	101	580	9.32	1,140

Daily gage height, in feet, of West Fork of Deschutes River near Lava, Oreg., for 1909.

[J. B. Heyburn, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		8.50	8.70	8.62	8.56	8.60	8.50	8.50	10.40
2		8.50	8.74	8.60	8.56	8.60	8.50	8.45	10.00
3		8.50	8.78	8.60	8.56	8.65	8.50	8.45	10.00
4		8.50	8.81	8.60	8.56	8.65	8.50	8.40	10.00
5		8.50	8.82	8.72	8.58	8.65	8.50	8.40	10.00
6		8.50	8.82	8.75	8.58	8.60	8.50	8.40	9.60
7		8.50	8.82	8.65	8.58	8.60	8.48	8.40	9.40
8		8.50	8.87	8.68	8.58	8.60	8.48	8.40	9.40
9		8.50	8.87	8.68	8.58	8.60	8.48	8.40	9.40
10		8.62	8.85	8.65	8.58	8.60	8.45	8.40	9.40
11		8.61	8.80	8.65	8.58	8.60	8.45	8.40	9.40
12		8.60	8.76	8.60	8.58	8.60	8.45	8.35	9.40
13		8.58	8.75	8.60	8.60	8.60	8.43	8.35	9.33
14		8.58	8.82	8.58	8.60	8.60	8.40	8.30	9.30
15		8.55	8.75	8.58	8.60	8.55	8.40	8.30	9.30
16		8.53	8.78	8.58	8.60	8.55	8.40	8.35	9.20
17		8.50	8.90	8.58	8.60	8.55	8.40	8.38	9.10
18		8.48	8.90	8.55	8.60	8.55	8.40	8.40	9.00
19		8.48	8.90	8.55	8.60	8.55	8.40	8.42	9.00
20		8.45	8.85	8.55	8.60	8.55	8.40	8.80	9.00
21		8.43	8.80	8.55	8.60	8.55	8.40	8.80	9.00
22		8.41	8.76	8.55	8.60	8.55	8.40	9.35	8.90
23	8.40	8.41	8.75	8.55	8.60	8.55	8.40	10.15	[a] 10.15
24	8.40	8.42	8.70	8.55	8.60	8.55	8.40	10.15	[a] 11.80
25	8.40	8.42	8.70	8.55	8.60	8.55	8.40	11.20	[a] 11.50
26	8.40	8.42	8.70	8.55	8.60	8.60	8.40	11.50	9.00
27	8.50	8.49	8.68	8.56	8.60	8.60	8.40	11.30	8.70
28	8.50	8.52	8.67	8.56	8.60	8.58	8.40	11.00	8.70
29	8.50	8.58	8.65	8.56	8.60	8.50	8.40	10.70	8.70
30	8.50	8.65	8.65	8.56	8.60	8.50	8.40	10.40	8.70
31		8.70		8.56	8.60		8.50		8.70

[a] Gage heights affected by ice jam below the station.

Daily discharge, in second-feet, of West Fork of Deschutes River near Lava, Oreg., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	980	1,020	1,000	992	1,000	980	980	1,450
2	.....	980	1,040	1,000	992	1,000	980	970	1,350
3	.....	980	1,040	1,000	992	1,010	980	970	1,350
4	.....	980	1,050	1,000	992	1,010	980	960	1,350
5	.....	980	1,060	1,030	996	1,010	980	960	1,350
6	.....	980	1,060	1,040	996	1,000	980	960	1,250
7	.....	980	1,060	1,010	996	1,000	976	960	1,200
8	.....	980	1,070	1,020	996	1,000	976	960	1,200
9	.....	980	1,070	1,020	996	1,000	976	960	1,200
10	.....	1,000	1,060	1,010	996	1,000	970	960	1,200
11	.....	1,000	1,050	1,010	996	1,000	970	960	1,200
12	.....	1,000	1,040	1,000	996	1,000	970	950	1,200
13	.....	996	1,040	1,000	1,000	1,000	966	950	1,180
14	.....	996	1,060	996	1,000	1,000	960	940	1,180
15	.....	990	1,040	996	1,000	990	960	940	1,180
16	.....	986	1,040	996	1,000	990	960	950	1,150
17	.....	980	1,080	996	1,000	990	960	956	1,120
18	.....	976	1,080	990	1,000	990	960	960	1,100
19	.....	976	1,080	990	1,000	990	960	964	1,100
20	.....	970	1,060	990	1,000	990	960	1,050	1,100
21	.....	966	1,050	990	1,000	990	960	1,050	1,100
22	.....	962	1,040	990	1,000	990	960	1,190	1,080
23	960	962	1,040	990	1,000	990	960	1,390	1,080
24	960	964	1,020	990	1,000	990	960	1,390	1,090
25	960	964	1,020	990	1,000	990	960	1,680	1,100
26	960	964	1,020	990	1,000	1,000	960	1,770	1,100
27	980	978	1,020	992	1,000	1,000	960	1,710	1,020
28	980	984	1,020	992	1,000	996	960	1,620	1,020
29	980	996	1,010	992	1,000	980	960	1,530	1,020
30	980	1,010	1,010	992	1,000	980	960	1,450	1,020
31	.....	1,020	.....	992	1,000	.....	980	.....	1,020

NOTE.—These discharges were obtained from a rating curve which is fairly well defined below 1,200 second-feet. The flow during the summer months is affected by weeds in the stream bed, and discharges are somewhat uncertain. Dec. 23–25 interpolated on account of ice.

Monthly discharge of West Fork of Deschutes River near Lava, Oreg., for 1909.

[Drainage area, 500 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
April 23–30	980	960	970	1.94	0.58	15,400	B.
May	1,020	962	983	1.97	2.27	60,400	B.
June	1,080	1,010	1,040	2.08	2.32	61,900	B.
July	1,040	990	1,000	2.00	2.31	61,500	B.
August	1,000	992	998	2.00	2.31	61,400	B.
September	1,010	980	996	1.99	2.22	59,300	B.
October	980	960	967	1.93	2.22	59,500	B.
November	1,770	940	1,130	2.26	2.52	67,200	B.
December	1,450	1,020	1,160	2.32	2.68	71,300	B.
The period	.....	.....	.....	.....	.....	518,000	

TUMALO CREEK DRAINAGE BASIN.

DESCRIPTION.

Tumalo Creek rises on Ball Butte in the southwestern part of Crook County, Oreg., and flows in a general easterly course to its junction with Deschutes River, about 4 miles south of Laidlaw.

The Columbia Southern Irrigation Co. selected about 27,000 acres of land for development under the terms of the Carey Act. Land with water rights was sold to settlers, and construction of canals was begun before any knowledge was obtained of the flow of the stream. Later it was found that the water was not sufficient for more than about one-third of the land and considerable litigation followed.

TUMALO CREEK NEAR LAIDLAW, OREG.

This station was first established May 15, 1906, one-half mile above the head gate of the Columbia Southern canal in sec. 2, T. 18 S., R. 10 E. At this point records were obtained during the irrigation season only, observations being furnished by the patrolman in the employ of the irrigation company. During the winter no patrolman was kept at the head gates, and a substitute station was kept at a bridge on the Bend-Sisters Road, 6 miles downstream. As first located the station was below the intake of the Wimer canal and during the period from May 15, 1906, to April 1, 1908, the flow in Wimer canal should be added to that in Tumalo Creek to obtain the natural flow at this point. On the latter date, however, the Tumalo Creek station was moved to a point 1½ miles above the intake of the Columbia Southern canal and 300 feet above the Wimer canal.[1] Gages at the new station are not comparable with those at the old. During 1909 arrangements were made whereby winter records were secured.

The records of gage height are furnished without cost to the Survey by the Columbia Southern Irrigation Co.

Discharge measurements of Tumalo Creek near Laidlaw, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	R. B. Post	31.5	39.5	2.41	98
May 29	do	32.5	60	2.96	208
Aug. 1	do	31.4	43	2.40	108

Daily gage height, in feet, of Tumalo Creek near Laidlaw, Oreg., for 1909.

[C. A. Reeves, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.12	2.15	2.13	.....	.....	3.45	2.88	2.40	2.20	2.18
2	2.13	2.15	2.12	.....	.....	3.67	2.90	2.37	2.47	.....
3	2.15	2.15	2.12	.....	.....	.....	3.03	2.35	.....	2.18
4	2.12	2.10	2.12	.....	.....	3.40	2.95	2.35	2.25	.....
5	2.06	2.12	2.12	.....	.....	3.35	.....	2.33	2.23	2.18
6	2.10	2.14	2.12	.....	2.70	.....	2.78	2.30	2.21	2.25
7	2.15	2.14	2.12	.....	2.75	3.15	.....	2.27	2.20	2.18
8	2.13	2.13	2.10	.....	2.77	3.08	2.75	2.26	2.20	2.16
9	2.10	2.13	2.10	.....	.....	3.08	2.74	2.27	2.19	2.16
10	2.10	2.13	2.10	.....	.....	3.14	2.83	2.31	2.23	2.17

[1] See descriptions of stations on these canals, pp. 407–408.

Daily gage height, in feet, of Tumalo Creek near Laidlaw, Oreg., in 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
11	2.05	2.13	2.10	.....	2.95	3.07	2.98	2.29	2.18	2.18
12	2.04	2.13	2.12	.....	2.00	3.17	2.87	2.29	2.17	2.17
13	2.15	2.13	2.12	.....	2.58	3.13	.....	2.27	2.15	2.15
14	2.13	2.12	2.12	.....	2.58	3.28	2.79	2.27	2.16	2.16
15	2.16	2.12	2.12	.....	.....	.....	2.67	2.25	2.17	2.15
16	2.18	2.14	2.13	.....	2.65	3.15	2.66	2.23	2.16	2.15
17	2.20	2.20	2.15	.....	2.63	3.16	2.60	2.25	2.18	2.15
18	2.18	2.18	2.13	.....	2.65	3.05	2.50	2.24	2.16	2.17
19	2.20	2.16	2.14	.....	2.68	3.05	2.48	2.25	2.15	.....
20	2.25	2.16	2.13	.....	.....	.....	2.49	2.27	2.16	2.16
21	2.28	2.14	2.13	.....	.....	3.05	2.50	2.25	2.17	2.16
22	2.20	2.12	2.13	.....	.....	3.03	2.55	2.22	.....	2.16
23	2.20	2.14	2.13	.....	2.63	3.15	2.57	2.21	.....	2.15
24	2.20	2.15	2.13	.....	2.66	3.05	2.53	2.20	2.16	2.15
25	2.18	2.14	2.13	.....	2.76	.....	2.55	2.20	2.17	2.15
26	2.18	2.14	2.15	.....	2.90	3.12	2.50	2.27	2.18	2.15
27	2.18	2.14	2.17	.....	3.05	3.00	2.40	2.25	2.18	2.15
28	2.18	2.13	2.17	.....	2.97	2.88	2.40	2.20	2.18	2.15
29	2.18	.....	2.16	.....	.....	2.85	2.38	2.20	2.20	2.16
30	2.18	.....	2.15	.....	3.20	2.88	2.41	2.20	.....	2.15
31	2.16	.....	2.14	.....	3.10	.....	2.43	2.19	.....	.....

Daily discharge, in second-feet, of Tumalo Creek near Laidlaw, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	75	78	76	.....	150	362	191	108	83	81
2	76	78	75	.....	150	440	195	104	118	81
3	78	78	75	.....	150	392	226	102	104	81
4	75	79	75	.....	150	345	206	102	89	81
5	69	75	75	.....	150	328	188	99	87	81
6	73	77	75	.....	155	295	170	95	84	89
7	78	77	75	.....	164	262	167	91	83	81
8	76	76	73	.....	168	240	164	90	83	79
9	73	76	73	.....	181	240	163	91	82	79
10	73	76	73	.....	193	258	180	96	87	80
11	68	76	73	.....	206	238	213	94	81	81
12	68	76	75	.....	137	268	189	94	80	80
13	78	76	75	.....	134	255	180	91	78	78
14	76	75	75	.....	134	303	172	91	79	79
15	79	75	75	.....	140	282	150	89	80	78
16	81	77	76	.....	146	262	148	87	79	78
17	83	83	78	.....	142	265	137	89	81	78
18	81	81	76	.....	146	232	122	88	79	80
19	83	79	77	.....	151	232	119	89	78	80
20	89	79	76	.....	149	232	121	91	79	79
21	93	77	76	.....	146	232	122	89	80	79
22	83	75	76	.....	144	226	130	85	80	79
23	83	77	76	.....	142	262	132	84	79	78
24	83	78	76	.....	148	232	126	83	79	78
25	81	77	76	.....	166	242	130	83	80	78
26	81	77	78	.....	195	252	122	91	81	78
27	81	77	80	.....	232	218	108	89	81	78
28	81	76	80	.....	211	191	108	83	81	78
29	81	.....	79	.....	244	184	105	83	83	79
30	81	.....	78	.....	277	191	109	83	82	78
31	79	.....	77	.....	246	.....	112	82	.....	78

NOTE.—These discharges were obtained from a rating curve that is fairly well defined. Discharges May 1–5 estimated. Discharges interpolated for other days having no gage heights.

Monthly discharge of Tumalo Creek near Laidlaw, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	89	68	78.7	4,840	B.
February	83	75	77.2	4,290	B.
March	80	73	77.9	4,670	B.
April	.....	.....	91.1	5,420	C.
May	277	134	169	10,400	A.
June	440	184	265	15,800	A.
July	226	105	152	9,350	A.
August	108	82	90.8	5,580	A.
September	118	78	83.3	4,960	A.
October	89	78	79.5	4,890	A.
The period	.....	.....	.....	70,200	

NOTE.—Mean discharge for April estimated to be 20 per cent greater than that for March.

LEWIS CREEK NEAR LAIDLAW, OREG.

Lewis Creek is a mountain stream about 1½ miles long that rises in Lewis Lake, a small lake in the Cascade Range, and enters Tumalo Creek 2 miles above the intake of the Columbia Southern canal.

The station was established April 2, 1908, at the trail crossing near the mouth of the creek near Laidlaw, Oreg. The vertical staff gage is on the left bank about 6 feet above the trail crossing. Discharge measurements are made from a small foot log.

The data will be valuable in the study of possible storage development in the basin of Tumalo Creek.

No discharge measurements were made during 1909.

Daily gage height, in feet, of Lewis Creek near Laidlaw, Oreg., for 1909.

[C. A. Reeves, observer.]

Date.	Gage height.	Date.	Gage height.
Jan. 2	0.62	Mar. 27	0.58
Jan. 9	.56	Sept. 8	.50
Jan. 16	.58	Sept. 17	.50
Jan. 23	.60	Sept. 24	.50
Jan. 30	.60	Sept. 26	.60
Feb. 6	.60	Oct. 5	.50
Feb. 14	.58	Oct. 7	.51
Feb. 20	.60	Oct. 15	.51
Feb. 27	.58	Oct. 17	.51
Mar. 6	.58	Oct. 22	.55
Mar. 13	.56	Oct. 28	.52
Mar. 20	.58		

SQUAW CREEK AND M'ALLISTER'S DITCH NEAR SISTERS, OREG.

Squaw Creek rises in the Cascade Range in the southwestern part of Crook County, Oreg., and flows northeastward to its junction with Deschutes River. Its waters are used extensively for irrigation in small ditches. Segregations of large areas of land have been made for reclamation under the provisions of the Carey Act to be irrigated from this creek.

The station on Squaw Creek was established June 15, 1906. It is located 4 miles south of Sisters and above all present ditches except

McAllister's ditch. McAllister's ditch heads a short distance above the station, and the amount diverted in this ditch should be added to that measured in the creek in order to determine the natural flow of the stream at this point. The vertical staff gage on the creek is located on the right bank about 3 feet above a foot log used in making discharge measurements. The station on the ditch is located just above the wasteway gate. Measurements are made from cross timbers on the upstream side of this wasteway.

A short distance below the station a temporary brush dam is constructed each year to divert water into McAllister's ditch. This is altered by freshets and washed away in the fall. On this account the records of flow are not as reliable as could be desired.

The following discharge measurement was made by R. B. Post:

May 29, 1909: Width, 7.7 feet; area, 12.9 square feet; gage height, 1.60 feet; discharge, 17.4 second-feet.

Discharge measurements of Squaw Creek near Sisters, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
May 29	R. B. Post	30.5	37.6	3.6	109
Oct. 14	do	31.5	38	3.22	61

Daily gage height, in feet, of Squaw Creek near Sisters, Oreg., for 1909.

[Samuel Wiehl, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.8				3.55	4.1	4.0	3.85	3.45	3.25	3.85	3.85
2	3.8				3.55	4.3	4.15	3.85	4.05	3.25	3.7	3.85
3	3.7				3.65	4.2	4.15	3.8	3.65	3.2	3.6	3.75
4	3.2				3.8	4.2	4.15	3.75	3.6	3.2	3.6	3.6
5	3.3				3.7	4.2	4.05	3.75	3.5	3.2	3.25	3.5
6	3.7				3.65	4.15	3.9	3.6	3.5	3.3	3.25	3.65
7	3.9				3.65	4.0	3.75	3.6	3.5	3.25	3.25	3.5
8	4.0				3.75	3.9	3.7	3.65	3.5	3.2	3.2	3.5
9	4.0				3.65	3.9	3.85	3.75	3.45	3.2	3.2	3.45
10	4.1				3.6	4.1	3.85	3.8	3.4	3.25	3.55	3.35
11	4.1				3.55	4.05	3.95	3.8	3.3	3.25	3.55	3.35
12	4.2				3.45	4.1	4.0	3.7	3.3	3.2	3.4	3.45
13					3.45	4.0	3.9	3.7	3.4	3.2	3.6	3.55
14					3.45	4.15	3.95	3.6	3.35	3.3	3.35	3.5
15					3.5	4.2	4.0	3.6	3.4	3.2	3.25	3.5
16					3.5	4.3	3.95	3.55	3.4	3.2	3.4	3.5
17					3.5	4.1	3.85	3.55	3.4	3.2	3.4	3.65
18				3.3	3.5	4.0	3.7	3.75	3.25	3.2	3.9	3.65
19				3.5	3.55	4.05	3.7	3.9	3.2	3.25	4.65	3.65
20				3.3	3.55	4.05	3.75	3.65	3.2	3.2	4.5	3.6
21				3.3	3.55	4.0	3.75	3.6	3.2	3.15	4.3	3.65
22				3.3	3.55	4.1	3.85	3.5	3.2	3.15	7.5	3.75
23				3.3		4.1	3.9	3.5	3.25	3.1	5.5	4.0
24				3.3	3.55	4.1	3.9	3.45	3.25	3.15	4.4	4.1
25				3.35	3.65	4.1	3.8	3.45	3.3	3.15	4.15	4.15
26				3.5	3.75	4.2	3.75	3.75	3.3	3.15	4.0	4.2
27				3.5	3.85	4.1	3.65	3.55	3.25	3.15	3.95	4.2
28				3.45	3.75	3.9	3.65	3.45	3.35	3.15	3.95	4.6
29				3.45	3.65	3.9	3.65	3.5		3.15	3.85	5.8
30				3.4	3.8	3.95	3.75	3.5	3.2	3.2	3.85	5.8
31					4.0		3.85	3.5		3.2		3.15

NOTE.—Ice affected the gage heights Jan. 1 to 13 and Nov. 10 to 31. No observations Jan. 13 to Apr. 17, because the gage was out of plumb, due to the ice jam in January.

Daily discharge, in second-feet, of Squaw Creek near Sisters, Oreg., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	101	195	175	148	86	66	144
2	.....	101	245	208	148	185	66	123
3	.....	116	220	208	139	116	60	108
4	.....	139	220	208	131	108	60	108
5	.....	123	220	185	131	94	60	66
6	.....	116	208	156	108	94	71	66
7	.....	116	175	131	108	94	66	66
8	.....	131	156	123	126	94	60	60
9	.....	116	156	148	131	88	60	60
10	.....	108	195	148	139	82	66	.....
11	.....	101	185	166	139	71	66	.....
12	.....	88	195	175	123	71	60	.....
13	.....	88	175	156	123	82	60	.....
14	.....	88	208	166	108	76	71	.....
15	.....	94	220	175	108	82	60	.....
16	.....	94	245	166	101	82	60	.....
17	.....	94	195	148	101	82	60	.....
18	71	94	175	123	131	66	60	.....
19	94	101	185	123	156	60	66	.....
20	71	101	185	131	116	60	60	.....
21	71	101	175	131	108	60	55	.....
22	71	101	195	148	94	60	55	.....
23	71	101	195	156	94	60	50	.....
24	71	101	195	156	88	66	55	.....
25	76	116	195	139	88	71	55	.....
26	94	131	220	131	131	71	55	.....
27	94	148	195	116	101	66	55	.....
28	88	131	156	116	88	76	55	.....
29	88	116	156	116	94	68	55	.....
30	82	139	166	131	94	60	60	.....
31	.....	175	.....	148	94	.....	60	.....

NOTE.—These discharges were obtained from a rating curve which is fairly well defined below 108 second-feet.

Monthly discharge of Squaw Creek near Sisters, Oreg., for 1909.

[Drainage area, 90 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
Apr. 18–30	94	71	80.2	0.891	0.43	2,070	B.
May	175	88	112	1.24	1.43	6,890	B.
June	245	156	194	2.16	2.41	11,500	B.
July	208	116	152	1.69	1.95	9,350	B.
August	156	88	116	1.29	1.49	7,130	B.
September	185	60	81.0	.900	1.00	4 820	B.
October	71	50	60.3	.670	.77	3,710	B.
Nov. 1–9	144	60	89.0	.989	.33	1,590	C.
The period	.....	.....	.....	.....	.....	47,100	

Daily gage height, in feet, of McAllister ditch near Sisters, Oreg., for 1909.

[Samuel Wiehl, observer.]

Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Day.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	1.8	1.6	1.5	1.3	1.15	1.6	16	1.4	2.0	1.65	1.3	1.3	1.15	1.3
2	1.5	1.95	1.7	1.5	1.5	1.15	1.5	17	1.4	1.8	1.6	1.3	1.3	1.15	1.3
3	1.5	1.9	1.7	1.4	1.4	1.1	1.45	18	1.4	1.7	1.55	1.45	1.2	1.15	1.2
4	1.6	1.9	1.7	1.4	1.35	1.1	1.45	19	1.45	1.7	1.5	1.6	1.2	1.2	1.25
5	1.6	1.9	1.6	1.4	1.35	1.1	1.25	20	1.55	1.65	1.55	1.4	1.2	1.15	1.2
6	1.55	1.85	1.6	1.35	1.35	1.2	1.2	21	1.4	1.6	1.55	1.45	1.15	1.1	1.15
7	1.5	1.80	1.5	1.3	1.4	1.1	1.2	22	1.4	1.7	1.6	1.4	1.15	1.1	1.9
8	1.6	1.8	1.5	1.4	1.35	1.1	1.2	23	.....	1.7	1.6	1.35	1.2	1.1	.....
9	1.5	1.75	1.65	1.5	1.3	1.1	1.2	24	1.45	1.7	1.6	1.3	1.2	1.1	.....
10	1.5	1.9	1.65	1.55	1.3	1.15	1.55	25	1.5	1.7	1.5	1.3	1.2	1.1	.....
11	1.45	1.9	1.7	1.55	1.2	1.15	1.55	26	1.55	1.8	1.45	1.45	1.2	1.1	.....
12	1.4	1.9	1.7	1.5	1.2	1.15	1.45	27	1.7	1.7	1.4	1.3	1.2	1.1	.....
13	1.4	1.7	1.65	1.5	1.3	1.15	1.55	28	1.75	1.6	1.4	1.3	1.25	1.1	.....
14	1.4	1.75	1.7	1.45	1.25	1.3	1.2	29	1.6	1.6	1.4	1.3	.....	1.1	.....
15	1.4	1.8	1.7	1.45	1.3	1.15	1.1	30	1.7	1.6	1.45	1.3	1.15	1.15	.....
								31	1.8	.....	1.5	1.3	.....	1.15	.....

CROOKED RIVER DRAINAGE BASIN.

DESCRIPTION.

Crooked River, the principal tributary of Deschutes River from the east, rises in the Blue Mountains in the eastern part of Crook County, Oreg., is about 125 miles long, and drains a total area of about 2,920 square miles. The principal tributaries are Bear, Beaver, and Ochoco creeks.

The river flows through a narrow valley, in some places a mere gorge and in others opening out to a width of more than a mile. The topography of the basin is varied and picturesque. For about 25 miles above the mouth the contiguous table land is rolling and is covered with a sparse growth of juniper. Above this point the surface is more broken, and low hills rise rapidly to lofty mountains covered with a heavy growth of pine timber. The prominent topographic features are the abrupt rim rocks along the watercourses and the deeply eroded sides of the mountains that rise above the lava flow. Altitudes range from 2,500 feet to 6,000 feet above sea level. The principal rocks of the region are basaltic lava, sandstone, and allied sedimentary rocks and some dikes of a porphyritic material, and these rocks disintegrated make up the soil.

Approximately 20 per cent of the drainage area is forested with pine timber. The annual rainfall at Prineville is about 9 inches, but it is much greater in the higher altitudes. As this precipitation is well distributed throughout the year some crops can be raised without irrigation, but no successful general agriculture is possible without irrigation.

Although nearly the entire flow of the stream is used for irrigation during the irrigating season, no effort has been made to store the flood

water of the river in order to increase the summer flow. In addition to the reservoir site at Stewart's grade, about 12 miles above Post, there are many other places along the river where dams could be constructed and water stored for irrigation and power development, the most important site being at Summit Prairie, on the North Fork.

CROOKED RIVER NEAR POST, OREG.

This station was established November 9, 1908, at Stewart's grade, in the deep canyon 12 miles above Post and 6½ miles below the mouth of North Fork of Crooked River, at a proposed site for a dam that will impound a large amount of water for irrigation. It is about half a mile below the junction of the North Fork of Crooked River.

The staff gage is on the right bank at the cable from which discharge measurements are made. On October 22, 1909, the gage datum was lowered 1 foot and all 1909 readings corrected to the new datum. The gage heights for 1908, published in Water-Supply Paper 252, page 327, should be increased 1 foot to be comparable with the 1909 gage heights.

Discharge measurements of Crooked River near Post, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Nov. 9	R. B. Post	43	32	0.15	53
1909.					
Feb. 17	do	93	331	4.60	1,300
Apr. 6	do	88	256	3.35	811
June 11	do	34	28	1.10	55
Oct. 22	do	42	28	1.00	57

Daily gage height, in feet, of Crooked River near Post, Oreg., for 1909.

[W. L. Harris and F. J. Stewart, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.20	2.20	2.35	4.70	2.85	1.70	0.70	0.85	0.51	0.88	1.02	3.00
2	1.20	2.15	2.40	4.90	3.10	1.60	.75	.83	.60	.93	1.04	3.25
3	1.20	2.00	2.30	5.00	3.45	1.50	.75	.80	.65	.92	1.10	3.85
4	1.20	2.00	2.70	4.50	3.20	1.49	.75	.80	.65	1.00	1.15	3.85
5	1.20	1.75	3.10	4.10	2.85	1.48	.75	.80	.65	1.00	1.16	3.85
6	1.20	1.58	3.00	3.32	2.60	1.38	.80	.74	.91	1.00	1.17	3.85
7	1.20	1.58	2.80	3.10	2.40	1.30	.88	.70	.75	1.00	1.19	3.85
8	1.20	1.56	2.50	3.20	2.20	1.19	.90	.65	.71	1.00	1.19	3.85
9	1.20	1.55	2.30	3.20	2.35	1.14	.90	.63	.71	1.00	1.20	3.85
10	1.20	1.55	2.20	3.20	2.30	1.10	1.00	.60	.71	1.00	1.20	3.85
11	1.20	1.55	2.10	.....	2.10	1.10	1.17	.60	.71	1.00	1.20	3.85
12	1.20	1.55	2.00	.....	2.15	1.00	1.00	.59	.77	1.00	1.20	3.85
13	1.20	2.50	2.00	.....	2.10	1.00	.85	.60	.85	1.00	1.20	3.85
14	1.20	3.00	2.50	.....	2.00	.97	.83	.60	.85	1.00	1.22	3.85
15	1.20	3.70	3.10	.....	1.90	1.00	.82	.60	.85	1.00	1.22	3.85
16	1.20	4.00	3.90	.....	1.85	.97	.82	.60	.83	1.00	1.25	3.85
17	6.20	4.72	4.00	4.40	1.90	1.00	.80	.56	.81	1.00	1.27	3.85
18	5.72	3.70	3.50	3.95	1.83	1.10	.83	.53	.78	1.00	1.28	3.85
19	3.70	3.03	3.20	3.85	1.75	1.05	.82	.50	.80	1.00	1.31	3.85
20	4.45	2.60	3.00	3.90	1.67	1.00	.80	.46	.80	1.00	2.30	3.85
21	4.90	2.03	2.80	3.60	1.62	.97	.76	.43	.84	.....	1.80	3.85
22	3.20	2.04	2.70	3.50	1.62	.95	.73	.43	86	1.00	7.20	3.85
23	2.60	2.10	2.70	3.50	1.62	.90	.70	.43	90	1.00	7.50	3.85
24	2.20	2.30	3.60	3.25	1.60	.85	.70	.43	.84	1.00	6.50	3.85
25	2.13	2.20	4.25	3.50	1.58	.80	.70	.43	.81	1.00	4.19	3.85

Daily gage height, in feet, of Crooked River near Post, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	2.06	2.20	4.75	3.60	1.62	0.78	0.80	0.43	0.78	1.00	3.15	3.85
27	2.00	2.15	4.90	3.55	1.72	.75	.90	.42	.80	1.00	2.50	3.85
28	3.08	2.45	4.95	3.30	2.25	.73	.90	.43	.81	1.00	2.50	2.25
29	3.00	.....	5.10	3.12	1.98	.70	.90	.43	.78	1.00	2.70	2.25
30	2.75	.....	4.80	2.80	1.80	.70	.88	.43	.82	1.00	2.85	2.25
31	2.25	.....	4.25	.....	1.80	.....	.88	.43	.....	1.00	.....	2.25

NOTE.—Ice Jan. 1 to 19, Jan. 23 to about Feb. 12, and Dec. 3 to 31. Ice jam Jan. 18. Channel freezing over Jan. 23; frozen to bottom Jan. 28 and 30. Ice cut on Dec. 28 and found 18 inches thick. Gage height to water surface was 2.25 feet, instead of 3.85 feet as reported on several days previous by observer.

Daily discharge, in second-feet, of Crooked River near Post, Oreg., for 1908–9.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	74	11	55	67	21	67	60
2	.....	74	12	55	67	22	67	60
3	.....	74	13	67	67	23	74	60
4	.....	67	14	67	67	24	89	60
5	.....	67	15	67	60	25	67	60
6	.....	63	16	67	60	26	74	60
7	.....	65	17	67	60	27	74	60
8	.....	49	18	67	60	28	74	60
9	.....	49	19	67	60	29	74	60
10	55	67	20	67	60	30	74	60
						31	.....	60

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	54	218	342	1,430	535	156	17	28	6.5	31	45	600
2	54	206	360	1,540	645	135	20	27	11	36	48	712
3	54	172	325	1,600	805	115	20	24	14	35	55	402
4	54	172	475	1,330	690	113	20	24	14	43	61	402
5	54	126	645	1,130	535	111	20	24	14	43	62	402
6	54	98	600	744	435	94	24	20	34	43	63	402
7	54	98	515	645	360	81	31	17	20	43	66	402
8	54	95	395	690	290	66	33	14	18	43	66	402
9	54	94	325	690	342	60	33	13	18	43	67	402
10	54	94	290	690	325	55	43	11	18	43	67	402
11	54	94	260	774	260	55	63	11	18	43	67	402
12	54	94	230	859	275	43	43	10	22	43	67	402
13	54	395	230	943	260	43	28	11	28	43	67	402
14	54	880	395	1,030	230	40	27	11	28	43	70	402
15	54	930	645	1,110	203	43	26	11	28	43	70	402
16	67	1,080	1,030	1,200	191	40	26	11	27	43	74	402
17	355	1,440	1,080	1,280	203	43	24	9.0	25	43	77	402
18	642	930	830	1,060	186	55	27	7.5	23	43	78	402
19	930	614	690	1,000	168	49	26	6.0	24	43	83	402
20	1,300	435	600	1,030	150	43	24	4.8	24	43	325	402
21	1,540	239	515	880	139	40	21	3.9	28	43	179	402
22	690	242	475	830	139	38	19	3.9	29	43	3,040	402
23	435	260	475	830	139	33	17	3.9	33	43	3,250	402
24	290	325	880	712	135	28	17	3.9	28	43	2,550	402
25	269	290	1,200	830	131	24	17	3.9	25	43	1,180	402
26	248	290	1,460	880	139	23	24	3.9	23	43	668	402
27	230	275	1,540	855	161	20	33	3.6	24	43	395	402
28	477	378	1,570	735	308	19	33	3.9	25	43	395	246
29	450	.....	1,669	654	225	17	33	3.9	23	43	475	246
30	371	.....	1,480	515	179	17	31	3.9	26	43	535	246
31	231	.....	1,200	.....	179	.....	31	3.9	.....	43	.....	246

NOTE.—These daily discharges for 1908–9, except as noted, are based on a rating curve fairly well defined between 40 and 1,400 second-feet.

The gage heights for 1908 were increased 1 foot before applying the rating table. See description.

Discharges Nov. 27 to Dec. 2, 1908, interpolated; Dec. 15 to 31, 1908, reduced 10 per cent; Jan. 1 to 15, 1909, reduced 20 per cent; Jan. 17 and 18, interpolated; Jan. 28 to Feb. 12, reduced 25 per cent; Dec. 3 to 27, 1909, reduced 60 per cent; and Dec. 28 to 31, reduced 20 per cent to allow for ice conditions.

Monthly discharge of Crooked River near Post, Oreg., for 1908–9.

[Drainage area, 1,390 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
Nov. 10-30	89	55	68.3	0.049	0.04	2,840	C.
December	74	49	62.5	.045	.05	3,840	D.
1909.							
January	1,540	54	301	.217	.25	18,500	D.
February	1,440	94	377	.271	.28	20,900	C.
March	1,660	230	733	.527	.61	45,100	B.
April	1,600	515	950	.683	.76	56,500	B.
May	805	131	289	.208	.24	17,800	B.
June	156	17	56.6	.041	.05	3,370	C.
July	63	17	27.5	.020	.02	1,690	C.
August	28	3.9	10.9	.0078	.01	670	D.
September	34	6.5	22.6	.016	.02	1,350	C.
October	43	31	42.1	.030	.03	2,590	C.
November	3,250	45	475	.342	.38	28,200	B.
December	712	246	398	.286	.33	24,500	D.
The year	3,250	3.9	307	.221	2.98	221,000	

CROOKED RIVER NEAR PRINEVILLE, OREG.

This station was established October 31, 1908, at Stearn's ranch, 5½ miles southeast of Prineville, in sec. 36, T. 15 S., R. 15 E.

Measurements are made from a plank walk built on the side of a flume which is carried across the river on a trestle. The vertical staff gage is nailed to piling near the right bank about 6 feet upstream from the flume.

Discharge measurements of Crooked River near Prineville, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1908.					
Nov. 2	R. B. Post	84	181	0.70	62
Dec. 28[a]	do	85	160	.79	68
1909.					
Feb. 23	do	86	258	1.6	281
Apr. 12	do	90	454	3.72	1,290
June 9	do	85	157	.74	74
Oct. 29	do	84	144	.58	51

[a] Made through ice.

Daily gage height, in feet, of Crooked River near Prineville, Oreg., for 1909.

[Harley Sanders, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1		1.33	1.80	3.50	2.20	1.20	0.30	0.40	0.20	0.50		
2		1.33	2.00	4.00	2.20	1.15	.30	.40	.20	.50	0.60	1.92
3		1.43	2.50	4.80	2.40	1.10	.30	.41	.30	.50		
4		1.53	2.60	4.30	2.35	1.03	.22	.37	.28	.50	.65	1.20
5		1.43	2.80	3.60	2.40	.95	.25	.35	.30	.55		
6		1.43	2.40	3.10	2.20	.90	.30	.35	.30	.55	.70	1.50
7		1.13	2.10	2.70	2.00	.85	.35	.38	.30	.58	.70	
8		1.33	1.95	2.50	1.90	.80	.30	.35	.50	.59	.73	1.70
9		1.23	1.83	3.20	1.74	.80	.80	.35	.45	.59		
10		1.08	1.75	3.25	1.70	.70	.50	.30	.40	.59	.80	1.70

Daily gage height, in feet, of Crooked River near Prineville, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	.....	1.13	1.70	3.40	1.65	0.70	0.45	0.30	0.48	0.59	.....	1.50
12	.....	1.13	1.50	3.70	1.50	.70	.65	.20	.30	.60	0.80	1.52
13	.....	1.23	1.50	3.60	1.60	.70	.60	.23	.35	.....	.85	.....
14	.....	2.03	1.70	4.30	1.50	.60	.52	.25	.40	.60	.....	1.70
15	.....	1.93	2.10	4.20	1.40	.58	.50	.27	.45	.60	1.30	.....
16	.....	1.83	2.80	4.05	1.32	.58	.48	.25	.45	.....	.....	1.50
17	.....	5.03	3.40	4.20	1.27	.60	.50	.25	.45	.60	.70	.....
18	.....	3.93	3.40	3.80	1.30	.50	.50	.23	.49	.60	.....	1.40
19	.....	3.03	2.75	3.60	1.27	.50	.45	.20	.45	.60	.70	.....
20	2.15	2.53	2.60	3.25	1.20	.65	.45	.20	.45	.60	.....	1.40
21	2.15	2.13	2.40	3.20	1.20	.65	.45	.20	.45	.....	1.60	.....
22	2.00	1.83	2.30	2.95	1.10	.67	.45	.20	.45	.60	1.45	1.40
23	2.00	1.70	2.20	2.85	1.10	.60	.45	.20	.45	.....	6.80	.....
24	1.93	1.60	2.50	2.82	1.10	.55	.30	.20	.45	.60	6.60	1.40
25	1.93	1.90	3.20	2.60	1.00	.50	.30	.20	.45	.60	4.40	1.40
26	1.73	1.85	3.80	3.05	.90	.45	.30	.17	.55	.....	3.30	.....
27	1.53	1.70	4.20	3.00	1.00	.43	.30	.17	.45	.60	2.50	1.40
28	1.43	1.70	4.50	2.95	1.10	.40	.30	.17	.45	.....	2.00	.....
29	1.63	.....	4.30	2.75	1.60	.36	.30	.17	.50	.60	.....	1.40
30	1.63	.....	4.10	2.45	1.40	.35	.36	.20	.45	.60	1.90	.....
31	1.43	.....	3.40	.....	1.30	.....	.40	.20	.....	.65	.....	1.40

NOTE.—Ice conditions Jan. 2 to 19 and Dec. 20 to 31.

Daily discharge, in second-feet, of Crooked River near Prineville, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	65	194	350	1,150	510	160	28	35	22	43	56	394
2	65	194	430	1,810	510	148	28	35	22	43	53	398
3	65	224	650	1,930	600	135	28	36	28	43	56	279
4	65	256	700	1,630	575	121	23	33	27	43	59	160
5	65	224	800	1,210	600	106	25	32	28	48	62	202
6	65	224	600	950	510	96	28	32	28	48	65	245
7	65	142	470	750	430	88	32	34	28	51	65	280
8	65	194	410	650	390	79	28	32	43	52	69	315
9	65	168	362	1,000	329	79	79	32	39	52	74	315
10	65	131	332	1,020	315	65	43	28	35	52	79	315
11	65	142	315	1,100	298	65	39	28	41	52	79	245
12	65	142	245	1,270	245	65	59	22	28	53	79	252
13	65	168	245	1,210	280	65	53	24	32	53	88	284
14	65	442	315	1,630	245	53	45	25	35	53	136	315
15	65	402	470	1,570	215	51	43	26	39	53	185	280
16	150	362	800	1,480	191	51	41	25	39	53	125	245
17	250	2,080	1,100	1,570	178	53	43	25	39	53	65	230
18	300	1,410	1,100	1,330	215	43	43	24	35	53	65	215
19	400	915	775	1,210	178	43	39	22	39	53	65	194
20	490	665	700	1,020	160	59	39	22	39	53	172	172
21	490	482	600	1,000	160	59	39	22	39	53	280	172
22	430	362	550	875	135	61	39	22	39	53	230	172
23	430	315	510	825	135	53	39	22	39	53	3,340	172
24	416	280	650	810	135	48	28	22	39	53	3,180	172
25	402	390	1,000	700	115	43	28	22	39	53	1,690	172
26	326	370	1,330	925	96	39	28	20	48	53	1,050	172
27	256	315	1,570	900	115	37	28	20	39	53	650	172
28	224	315	1,750	875	135	35	28	20	39	53	430	172
29	290	.....	1,630	775	280	32	28	20	43	53	410	172
30	290	.....	1,510	625	215	32	32	22	39	53	390	172
31	224	.....	1,100	.....	185	.....	35	22	.....	59	.....	172

NOTE.—These discharges were obtained from a rating curve that is well defined between discharges 43 and 1,330 second-feet. Discharges Jan. 1 to 19 and Dec. 19 to 31, 1909, estimated because of ice conditions. Discharges interpolated for all other days when gage was not read.

Monthly discharge of Crooked River near Prineville, Oreg., for 1908–9.

[Drainage area, 1,990 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
November	.....	.....	[a] 65	0.033	0.04	3,870	C.
December	.....	.....	[a] 65	.033	.04	4,000	D.
1909.							
January	490	65	205	.103	.12	12,600	D.
February	2,080	131	411	.207	.22	22,800	A.
March	1,750	245	754	.379	.44	46,400	A.
April	1,930	625	1,130	.568	.63	67,200	A.
May	600	96	280	.141	.16	17,200	A.
June	160	32	68.8	.035	.04	4,090	A.
July	79	23	36.7	.018	.02	2,260	B.
August	36	20	26.0	.013	.01	1,600	C.
September	48	22	35.6	.018	.02	2,120	B.
October	59	43	51.4	.026	.03	3,160	A.
November	3,340	53	445	.224	.25	26,500	A.
December	398	172	233	.117	.13	14,300	C.
The year	3,340	20	306	.154	2.07	220,000	

[a] Monthly mean estimated.

NOTE.—Discharge for November and December, 1908, estimated to average 65 second-feet per day. Discharge Jan. 1 to 19 and Dec. 19 to 31 estimated on account of ice conditions.

OCHOCO CREEK AND ELLIOTT DITCH NEAR PRINEVILLE, OREG.

The station on Ochoco Creek was established October 29, 1908, at Elliott's ranch, 6 miles east of Prineville, Oreg., in the NE. ¼ sec. 5, T. 15 S., R. 17 E., on the dam site for a reservoir proposed in connection with the development of the Ochoco irrigation project by the United States Reclamation Service.

The vertical staff gage is fastened to an alder on the left bank just above the cable from which discharge measurements are made. The gage datum was lowered 0.75 foot July 15, 1909, and all 1909 readings corrected to the new datum. The gage heights in 1908, published in Water-Supply Paper No. 252, page 329, should be increased 0.75 foot to be comparable with the 1909 gage heights.

The Elliott Ditch diverts water from the left bank of the creek about 1,000 feet above the gaging station. Records are kept on the flow in the ditch in order to determine the natural flow of the creek. The vertical staff gage is installed in the ditch about 150 feet upstream from the creek gage. Discharge measurements are made from a foot plank.

Discharge measurements of Ochoco Creek near Prineville, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1908.					
Dec. 27	R. B. Post	12	70	0.10	5.5
1909.					
Feb. 22	do	45	29.9	1.28	66.3
Apr. 11	do	48	50.8	1.76	171
June 9	do	29	17	1.00	26
July 26	do	6.5	1.5	.4	1.2
Oct. 8	do	1	.2	.54	.06

Daily gage height, in feet, of Ochoco Creek near Prineville, Oreg., for 1909.

[David Elliott, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.25	1.55	1.35	1.85	1.75	1.35	.....	0.30	0.40	0.30	0.30	1.70
2	1.25	1.55	1.45	2.05	1.75	1.35	.....	.40	.50	.30	.30	1.60
3	1.05	1.55	1.45	2.15	1.65	1.25	.....	.50	.40	.30	.30	1.60
4	1.31	1.55	1.45	1.95	1.85	1.25	.....	.40	.50	.30	.30	1.50
5	1.31	1.55	1.55	1.85	1.75	1.15	.....	.50	.50	.30	.30	1.60
6	.....	1.55	1.55	1.85	1.85	1.05	.....	.50	.50	.30	.40	1.60
7	.....	1.55	1.45	1.65	1.65	1.15	.....	.50	.50	.30	.40	1.70
8	.....	1.55	1.55	1.85	1.65	1.15	.....	.50	.40	.40	.40	1.50
9	.....	1.55	1.45	1.75	1.65	1.00	.....	.50	.40	.30	.40	1.70
10	.....	1.55	1.35	1.85	1.65	.....	.....	.50	.40	.30	.40	1.60
11	.....	1.55	1.35	1.85	1.65	1.00	.....	.50	.40	.30	.30	1.50
12	.....	1.55	1.15	1.85	1.55	.85	.....	.50	.40	.30	.30	1.70
13	.....	1.55	1.35	1.95	1.55	.95	.....	.50	.40	.30	.40	1.60
14	.....	1.55	1.55	2.05	1.45	.....	.....	.50	.40	.40	.40	1.50
15	1.65	1.55	1.75	2.05	1.45	.85	0.60	.40	.40	.40	.50	1.50
16	1.65	1.65	1.85	2.15	1.45	.....	.....	.50	.40	.40	.50	1.50
17	1.70	2.75	2.25	2.15	1.35	.95	.60	.40	.30	.40	.40	1.50
18	1.95	1.65	1.85	2.05	1.35	.....	.50	.40	.30	.40	.40	1.60
19	2.05	1.65	1.75	1.95	1.35	1.05	.50	.40	.30	.40	.40	1.50
20	2.30	1.55	1.75	1.75	1.35	.....	.50	.40	.30	.40	.50	1.40
21	2.35	1.45	1.65	1.85	1.25	1.05	.50	.40	.30	.30	.60	1.60
22	1.65	1.25	1.65	1.75	1.25	.....	.50	.40	.30	.30	1.80	1.60
23	1.55	1.45	1.75	1.85	1.25	1.05	.40	.30	.30	.30	4.25	2.60
24	1.55	1.35	1.85	1.75	1.25	.....	.40	.40	.30	.30	3.40	2.60
25	1.35	1.35	1.85	1.75	1.25	.95	.40	.40	.30	.30	2.50	2.30
26	1.25	1.25	1.95	1.85	1.15	.....	.40	.40	.30	.30	2.20	2.20
27	1.55	1.25	2.05	1.85	1.25	.95	.30	.40	.30	.30	2.00	2.20
28	1.55	1.45	2.15	1.85	1.35	.....	.40	.40	.30	.30	1.90	2.20
29	1.55	.....	2.15	1.75	1.35	.....	.40	.40	.30	.30	1.90	2.10
30	1.55	.....	2.05	1.75	1.25	.....	.40	.40	.40	.30	1.90	2.00
31	1.55	.....	1.95	.....	1.25	.....	.40	.40	.....	.30	.....	1.50

NOTE.—Ice conditions Jan. 6 to 15.

Daily discharge, in second-feet, of Ochoco Creek at Elliott's ranch, near Prineville, Oreg., for 1908–9.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1908.			1908.			1908.		
1	.....	32	11	22	60	21	22	15
2	.....	22	12	22	60	22	60	15
3	.....	32	13	22	22	23	22	15
4	.....	32	14	22	22	24	22	15
5	.....	22	15	14	22	25	60	14
6	.....	60	16	60	32	26	60	14
7	.....	60	17	60	22	27	60	14
8	.....	60	18	60	22	28	60	14
9	22	60	19	22	22	29	22	14
10	22	60	20	22	15	30	22	14
						31	.....	14

Daily discharge, in second-feet, of Ochoco Creek at Elliott's ranch, near Prineville, Oreg., for 1908–9—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	14	109	75	168	147	75	16	0	0.5	0	0	137
2	14	109	92	211	147	75	15	.5	1.5	0	0	118
3	10	109	92	234	128	60	14	1.5	.5	0	0	118
4	20	109	92	189	168	60	13	.5	1.5	0	0	100
5	20	109	109	168	147	45	12	1.5	1.5	0	0	118
6	30	109	109	168	168	32	11	1.5	1.5	0	.5	118
7	40	109	92	128	128	45	10	1.5	1.5	0	.5	137
8	50	109	109	168	128	45	9	1.5	.5	.5	.5	100
9	60	109	92	147	128	26	8	1.5	.5	0	.5	137
10	70	109	75	168	128	26	7	1.5	.5	0	.5	118
11	80	109	75	168	128	26	6	1.5	.5	0	0	100
12	90	109	45	168	109	14	5	1.5	.5	0	0	137
13	100	109	75	189	109	22	4	1.5	.5	0	.5	118
14	122	109	109	211	92	18	3	1.5	.5	.5	.5	100
15	128	109	147	211	92	14	3	.5	.5	.5	1.5	100
16	128	128	168	234	92	18	3	1.5	.5	.5	1.5	100
17	137	408	259	234	75	22	3	.5	0	.5	.5	100
18	189	128	168	211	75	27	1.5	.5	0	.5	.5	118
19	211	128	147	189	75	32	1.5	.5	0	.5	.5	100
20	272	109	147	147	75	32	1.5	.5	0	.5	1.5	83
21	286	92	128	168	60	32	1.5	.5	0	0	3	118
22	128	60	128	147	60	32	1.5	.5	0	0	157	118
23	109	92	147	168	60	32	0.5	.5	0	0	981	360
24	109	75	168	147	60	27	0.5	.5	0	0	632	360
25	75	75	168	147	60	22	0.5	.5	0	0	330	272
26	60	60	189	168	45	21	0.5	.5	0	0	246	246
27	109	60	211	168	60	20	0	.5	0	0	200	246
28	109	92	234	168	75	19	0.5	.5	0	0	178	246
29	109	.....	234	147	75	18	0.5	.5	0	0	178	222
30	109	.....	211	147	60	17	0.5	.5	.5	0	178	200
31	109	.....	189	.....	60	.....	0.5	.5	.....	0	.....	100

NOTE.—The gage heights for 1908 were increased 0.75 foot before applying the rating table. See description.

The discharges for 1909 were obtained from a rating curve which is fairly well defined below discharge of 200 second-feet. Discharges Dec. 27, 1908, to Jan. 14, 1909, estimated on account of ice conditions. Discharge Dec. 20 to 24, 1908, estimated to average 15 second-feet per day. Discharges interpolated for all other days when gage was not read.

Monthly discharge of Ochoco Creek near Prineville, Oreg., for 1908–9.

[Drainage area, 300 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
November 9-30	60	0	35.5	0.118	0.08	1,550	C.
December	60	14	28.9	.096	.11	1,780	C.
The period	.....	.....	.....	.....	.....	.....	
1909.							
January	286	32	100	0.33	0.38	6,150	C.
February	408	60	112	.373	.39	6,220	B.
March	259	45	138	.460	.53	8,480	B.
April	234	128	176	.587	.65	10,500	B.
May	168	45	97.2	.324	.37	5,980	B.
June	75	14	31.8	.106	.12	1,890	B.
July	16	0	4.95	.016	.02	304	C.
August	1.5	0	0.87	.0029	.003	53	C.
September	1.5	0	.45	.0015	.002	27	D.
October	.5	0	.13	.00043	.0005	8	D.
November	981	0	103	.343	.38	6,130	C.
December	360	83	153	.510	.59	9,410	B.
The year	981	0	76.6	.255	3.44	55,200	

NOTE.—Discharge Dec. 20 to 24, 1908, estimated to average 15 second-feet per day. Discharge Dec. 27, 1908, to Jan. 14, 1909, estimated on account of ice conditions. Discharge interpolated for other days when gage was not read.

Discharge measurements of Elliott ditch near Prineville, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
June 29	R. B. Post	5	3.4	1.15	4.8
July 26	do	5	3.7	1.25	2.5
Oct. 8	do	3.5	.90	.55	.3

Daily gage height, in feet, of Elliott ditch near Prineville, Oreg., for 1909.

[David Elliott, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1		1.5			1.1			0.8
2		1.5						.8
3		1.5						.8
4		1.5						.9
5		1.3	1.3					.9
6			1.2					.9
7			1.2					.9
8			1.2					1.0
9			1.15				0.6	1.0
10							.7	1.0
11							.6	1.0
12			1.1				.6	1.0
13			1.1				.5	1.0
14							.6	1.0
15			1.0				.6	1.2
16							.6	1.0
17		1.3	1.2				.6	1.0
18		1.4					.6	1.0
19		1.5					1.6	1.0
20		1.5					.6	1.1
21	1.4	1.4		1.1			.6	1.1
22	1.4	1.4		1.1			.6	
23	1.5	1.4		1.3			.6	
24	1.5	1.4		1.3			.6	
25	1.5	1.4		1.3			.7	
26	1.6	1.3		1.3			.7	
27	1.6	1.3		1.1			.7	
28	1.6	1.5		1.0			.7	
29	1.6	1.3		1.0			.8	
30	1.6	1.2		1.0			.8	
31		1.3		1.0			.8	

NOTE.—There was little or no water in the ditch on days having no gage heights.

METOLIUS RIVER NEAR SISTERS, OREG.

This station was established October 31, 1908, at Rigg's ranch, 7 miles above the mouth of the stream and 26 miles northeast of Sisters, in sec. 28, T. 11 S., R. 11 E. A vertical staff gage is located about 50 feet upstream from the cable from which discharge measurements are made.

The results obtained here will be particularly valuable for water-power development and in making a general study of run-off conditions in the Deschutes River system. The stream throughout its course runs in a deep canyon and is entirely spring fed. The flow is well maintained throughout the year.

Discharge measurements of Metolius River near Sisters, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
1908.					
Oct. 22	R. B. Post	102	326	0.60	1,490
1909.					
Apr. 17	R. B. Post	101	338	0.74	1,600
Oct. 12	do	98	321	0.55	1,410

Daily gage height, in feet, of Metolius River near Sisters, Oreg., for 1909.

[D. N. Riggs, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0.6	0.8	0.8	0.8	0.8	0.9	0.8	0.7	0.6	0.6	0.6	1.1
2	.6	.8	.8	.8	.8	1	.8	.7	.6	.6	.8	1.0
3	.6	.8	.8	.8	.8	1	.8	.7	.65	.6	.7	.95
4	.6	.7	.8	.8	.9	1	.8	.7	.65	.6	.6	.95
5	.6	.7	.8	.8	.8	1	.8	.7	.65	.55	.6	.9
6	.6	.7	.8	.8	.8	.9	.8	.65	.6	.6	.55	.9
7	.6	.7	.8	.8	.8	.9	.8	.65	.6	.6	.55	.9
8	.6	.7	.8	.7	.8	.9	.8	.65	.6	.55	.55	.85
9	.6	.7	.8	.7	.8	.8	.75	.65	.6	.55	.....	.85
10	.6	.7	.8	.7	.8	.8	.75	.65	.6	.55	.55	.85
11	.5	.7	.7	.7	.8	.8	.8	.65	.6	.55	.55	.85
12	.5	.7	.7	.7	.8	.8	.8	.....	.6	.55	.55	1.2
13	.5	.7	.7	.7	.75	.85	.8	.65	.6	.55	.5	1.0
14	.5	.7	.7	.7	.75	.85	.75	.65	.6	.55	.5	1.0
15	.6	.7	.7	.7	.75	.9	.75	.65	.5	.55	.5	1.0
16	.8	1.0	.7	.7	.7	.9	.75	.65	.5	.55	.5	1.0
17	.8	1.0	.7	.75	.75	.9	.75	.65	.55	.55	.5	.9
18	.9	1.0	.7	.75	.75	.9	.7	.6	.55	.55	.7	.85
19	1.3	.9	.8	.75	.75	.85	.7	.6	.55	.57	1.1	.85
20	1.4	.9	.8	.75	.75	.85	.7	.6	.55	.55	1.7	.85
21	1.5	.9	.8	.75	.75	.85	.7	.6	.55	.55	.8	.85
22	1.2	.8	.8	.75	.75	.85	.7	.6	.55	.55	2.65	.8
23	1.1	.8	.8	.75	.75	.85	.7	.6	.55	.55	2.8	.8
24	1.0	.8	.7	.75	.75	.85	.7	.6	.55	.55	2.1	.8
25	.9	.8	.7	.75	.75	.8	.7	.6	.55	.5	1.65	.8
26	.9	.8	.7	.75	.75	.8	.7	.8	.55	.5	1.5	.8
27	.8	.8	.7	.75	.9	.8	.7	.7	.55	.5	1.5	.75
28	.8	.8	.8	.8	.85	.8	.7	.6	.55	.....	1.2	.75
29	.8	.....	.8	.8	.8	.8	.7	.6	.6	.5	1.1	.7
30	.8	.....	.8	.8	.8	.8	.7	.6	.6	.5	1.1	.8
31	.8	.....	.8	.....	.9	.....	.7	.6	.....	.6	.....	.8

Daily discharge, in second-feet, of Metolius River near Sisters, Oreg., for 1908–9.

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1908.				1908.				1908.			
1	.....	1,560	1,460	11	.....	1,460	1,460	21	.....	1,460	1,360
2	.....	1,460	1,460	12	.....	1,460	1,360	22	1,460	1,560	1,460
3	.....	1,460	1,460	13	.....	1,460	1,360	23	1,460	1,560	1,460
4	.....	1,460	1,460	14	.....	1,460	1,360	24	1,460	1,460	1,460
5	.....	1,460	1,460	15	.....	1,460	1,360	25	1,460	1,460	1,460
6	.....	1,460	1,460	16	.....	1,460	1,360	26	1,460	1,460	1,460
7	.....	1,460	1,460	17	.....	1,670	1,360	27	1,460	1,460	1,460
8	.....	1,460	1,460	18	.....	1,560	1,360	28	1,460	1,460	1,560
9	.....	1,460	1,460	19	.....	1,670	1,360	29	1,780	1,460	1,460
10	.....	1,460	1,460	20	.....	1,560	1,460	30	1,780	1,460	1,460
								31	1,560	.....	1,460

Daily discharge, in second-feet, of Metolius River near Sisters, Oreg., for 1908–9—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1909.												
1	1,460	1,670	1,670	1,670	1,670	1,780	1,670	1,560	1,460	1,460	1,460	2,030
2	1,460	1,670	1,670	1,670	1,670	1,900	1,670	1,560	1,460	1,460	1,670	1,900
3	1,460	1,670	1,670	1,670	1,670	1,900	1,670	1,560	1,460	1,460	1,560	1,840
4	1,460	1,560	1,670	1,670	1,780	1,900	1,670	1,560	1,510	1,460	1,460	1,840
5	1,460	1,560	1,670	1,670	1,720	1,900	1,670	1,560	1,510	1,410	1,460	1,780
6	1,460	1,560	1,670	1,670	1,670	1,780	1,670	1,510	1,510	1,460	1,410	1,780
7	1,460	1,560	1,670	1,670	1,670	1,780	1,670	1,510	1,460	1,460	1,410	1,780
8	1,460	1,560	1,670	1,560	1,670	1,780	1,670	1,510	1,460	1,410	1,410	1,720
9	1,460	1,560	1,670	1,560	1,670	1,670	1,620	1,510	1,460	1,410	1,410	1,720
10	1,460	1,560	1,670	1,560	1,670	1,670	1,620	1,510	1,460	1,410	1,410	1,720
11	1,360	1,560	1,560	1,560	1,670	1,670	1,670	1,510	1,460	1,410	1,410	1,720
12	1,360	1,560	1,560	1,560	1,670	1,670	1,670	1,510	1,460	1,410	1,410	2,160
13	1,360	1,560	1,560	1,560	1,620	1,720	1,670	1,510	1,460	1,410	1,360	1,900
14	1,360	1,560	1,560	1,560	1,620	1,720	1,620	1,510	1,460	1,410	1,360	1,900
15	1,360	1,560	1,560	1,560	1,620	1,720	1,620	1,510	1,360	1,410	1,360	1,900
16	1,670	1,900	1,560	1,560	1,560	1,780	1,620	1,510	1,360	1,410	1,360	1,900
17	1,670	1,900	1,560	1,620	1,620	1,780	1,620	1,510	1,410	1,410	1,360	1,780
18	1,780	1,900	1,560	1,620	1,620	1,780	1,560	1,460	1,410	1,410	1,560	1,720
19	2,300	1,780	1,670	1,620	1,620	1,720	1,560	1,460	1,410	1,430	2,030	1,720
20	2,440	1,780	1,670	1,620	1,620	1,720	1,560	1,460	1,410	1,410	2,860	1,720
21	2,580	1,780	1,670	1,620	1,620	1,720	1,560	1,460	1,410	1,410	1,670	1,720
22	2,160	1,670	1,670	1,620	1,620	1,720	1,560	1,460	1,410	1,410	4,260	1,670
23	2,030	1,670	1,670	1,620	1,620	1,720	1,560	1,460	1,410	1,410	4,500	1,670
24	1,900	1,670	1,560	1,620	1,620	1,720	1,560	1,460	1,410	1,410	3,420	1,670
25	1,780	1,670	1,560	1,620	1,620	1,670	1,560	1,460	1,410	1,360	2,790	1,670
26	1,780	1,670	1,560	1,620	1,620	1,670	1,560	1,670	1,410	1,360	2,580	1,670
27	1,670	1,670	1,560	1,620	1,780	1,670	1,560	1,560	1,410	1,360	2,580	1,620
28	1,670	1,670	1,670	1,670	1,720	1,670	1,560	1,460	1,410	1,360	2,160	1,620
29	1,670	.....	1,670	1,670	1,670	1,670	1,560	1,460	1,460	1,360	2,030	1,560
30	1,670	.....	1,670	1,670	1,670	1,670	1,560	1,460	1,460	1,360	2,030	1,670
31	1,670	.....	1,670	.....	1,780	.....	1,560	1,460	.....	1,460	.....	1,670

NOTE.—These discharges were obtained from a rating curve which is well defined between 1,400 and 1,800 second-feet.

Monthly discharge of Metolius River near Sisters, Oreg., for 1908–9.

[Drainage area, 400 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
1908.							
October 22–31	1,780	1,460	1,530	3.82	1.42	30,300	A.
November	1,670	1,460	1,490	3.72	4.15	88,700	A.
December	1,560	1,360	1,430	3.58	4.13	87,900	A.
The period	.....	.....	.....	.....	.....	207,000	
1909.							
January	2,580	1,360	1,670	4.18	4.82	103,000	B.
February	1,900	1,560	1,660	4.15	4.32	92,200	A.
March	1,670	1,560	1,630	4.08	4.70	100,000	A.
April	1,670	1,560	1,620	4.05	4.52	96,400	A.
May	1,780	1,560	1,660	4.15	4.78	102,000	A.
June	1,900	1,670	1,740	4.35	4.85	104,000	A.
July	1,670	1,560	1,610	4.02	4.64	99,000	A.
August	1,670	1,460	1,510	3.78	4.36	92,800	A.
September	1,510	1,360	1,440	3.60	4.02	85,700	A.
October	1,460	1,360	1,410	3.52	4.06	86,700	A.
November	4,500	1,360	1,960	4.90	5.47	117,000	A.
December	2,160	1,560	1,770	4.42	5.10	109,000	A.
The year	4,500	1,360	1,640	4.10	55.64	1,190,000	

CANALS AND DITCHES IN DESCHUTES RIVER BASIN.

CENTRAL OREGON AND PILOT BUTTE CANALS NEAR BEND, OREG.

The Central Oregon and Pilot Butte canals have a common head gate where water is diverted from Deschutes River, 3 miles above the town of Bend. They are operated for the reclamation of a large area of land segregated under the provisions of the Carey act by the Deschutes Irrigation & Power Co., by whom the gage-height records are furnished without cost to the Survey. The data obtained are valuable in a study of the hydrographic features of the Deschutes River system.

The station on the Central Oregon canal was established March 11, 1905. Measurements are made in a flume.

The station on the Pilot Butte canal was established March 6, 1905, half a mile below the wasteway and 1 mile below the point where the water diverted from Deschutes River is divided into the two canals. The measurements are made in an earth section and small changes in the channel have operated to diminish the accuracy of the results over what would have been obtained under stable channel conditions.

The water is turned out of these canals in freezing weather.

No discharge measurements were made on Pilot Butte canal during 1909.

The following discharge measurement was made by R. B. Post:

April 22, 1909: Width, 13 feet; area, 27.3 square feet; gage height, 2.10 feet; discharge, 144 second-feet.

Daily gage height, in feet, of Central Oregon canal near Bend, Oreg., for 1909.

[Deschutes Irrigation & Power Co., observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	0.7	1.55	1.45	2.15	2.45	2.72	2.22	2.45	2.05	1.8	.....
2	.....	.7	.75	1.45	2.18	1.48	2.75	2.38	2.42	2	.9	.....
3	.....	.9	.75	1.45	2.2	1.62	2.75	2.48	2.45	1.9	.....	0.3
4	.....	.9	.75	1.45	2.2	.9	2.78	2.48	2.3	1.8	.....	.3
5	.....	.9	.75	1.45	2.25	1.72	2.8	2.48	2.32	1.8	.....	.....
6	.....	1.2	.75	1.5	2.3	.65	2.8	2.62	2.3	1.8	.....	.....
7	.....	.75	.75	1.55	2.3	2.45	2.78	2.68	2.25	1.8	.....	.....
8	.....	.75	1.08	1.55	2.35	2.45	2.7	2.75	2.2	1.8	.....	.....
9	.....	.75	1.4	1.55	2.35	2.45	2.7	2.78	2.2	1.7	.....	.....
10	.....	.75	1.4	1.55	2.35	2.45	2.6	2.8	2.2	1.7	.....	.....
11	.....	.75	1.4	1.55	2.32	2.45	2.6	2.78	2.2	1.7	.....	.....
12	.....	.75	1.4	1.7	2.3	2.55	2.6	2.8	2.2	1.7	.....	.....
13	.....	.75	1.4	1.7	2.4	2.65	2.6	2.75	2.2	1.7	.9	.3
14	.....	.75	1.4	1.8	2.4	2.75	2.6	2.7	2.2	1.7	.9	.5
15	.....	1.15	1.4	1.9	2.4	2.75	2.65	2.7	2.2	1.7	.....	.45
16	.....	1.15	1.4	2	2.4	2.75	2.72	2.7	2.2	1.8	.....	1.15
17	.....	.75	1.4	2	2.4	2.72	2.85	2.7	2.2	1.8	.85	1.4
18	.....	.75	1.4	1.95	2.5	2.35	2.88	2.72	2.2	1.8	1.1	1.4
19	.....	.75	1.4	1.9	2.5	2.6	.....	2.7	2.2	1.8	1.4	.....
20	.....	.98	1.4	2	2.5	2.5	.....	2.68	2.2	1.8	1.7	.....
21	.....	.78	1.4	2.1	2.5	2.35	.....	2.75	2.2	1.8	1.7	.....
22	.....	.....	1.4	2.1	2.5	2.35	.....	2.72	2.2	1.8	.....	.....
23	.....	.....	1.4	2.12	2.5	2.4	.....	2.7	2.2	1.8	.....	.....
24	.....	.....	1.4	2.15	2.5	2.5	.....	2.68	2.2	1.8	.....	.....
25	.....	.....	1.4	2.15	2.5	2.6	.....	2.68	2.15	1.8	.....	.....

Daily gage height, in feet, of Central Oregon canal near Bend, Oreg., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	.....	1.55	1.4	2.15	2.55	2.62	.....	2.58	2.1	1.8	.....	.....
27	0.72	1.55	1.4	2.15	2.55	2.68	.....	2.58	2.1	1.8	.....	.....
28	1.45	1.55	1.4	2.15	2.5	2.7	.....	2.58	2.1	1.8	.....	.....
29	1.55	.....	1.35	2.15	2.45	2.7	0.75	2.45	2	1.75	.....	.....
20	1.12	.....	1.38	2.15	2.45	2.7	1.25	2.45	2.1	1.8	.....	.....
31	.7	.....	1.45	.....	2.45	.....	1.95	2.45	.....	1.8	.....	.....

Daily discharge, in second-feet, of Central Oregon canal near Bend, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0	28	99	89	171	214	257	181	214	157	126	0
2	0	28	31	89	175	92	262	203	209	150	41	0
3	0	41	31	89	178	106	262	219	214	138	0	8
4	0	41	31	89	178	41	267	219	192	126	0	8
5	0	41	31	89	185	117	270	219	195	126	0	0
6	0	65	31	94	192	25	270	241	192	126	0	0
7	0	31	31	99	192	214	267	251	185	126	0	0
8	0	31	54	99	199	214	254	262	178	126	0	0
9	0	31	84	99	199	214	254	267	178	115	0	0
10	0	31	84	99	199	214	238	270	178	115	0	0
11	0	31	84	99	195	214	238	267	178	115	0	0
12	0	31	84	115	192	230	238	270	178	115	0	0
13	0	31	84	115	206	246	238	262	178	115	41	8
14	0	31	84	126	206	262	238	254	178	115	41	17
15	0	60	84	138	206	262	246	254	178	115	0	14
16	0	60	84	150	206	262	257	254	178	126	0	60
17	0	31	84	150	206	257	278	254	178	126	38	84
18	0	31	84	144	222	199	283	257	178	126	56	84
19	0	31	84	138	222	238	0	254	178	126	84	0
20	0	47	84	150	222	222	0	251	178	126	115	0
21	0	33	84	164	222	199	0	262	178	126	115	0
22	0	0	84	164	222	199	0	257	178	126	0	0
23	0	0	84	167	222	206	0	254	178	126	0	0
24	0	0	84	171	222	222	0	251	178	126	0	0
25	0	0	84	171	222	238	0	251	171	126	0	0
26	.....	99	84	171	230	241	0	235	164	126	0	0
27	29	99	84	171	230	251	0	235	164	126	0	0
28	89	99	84	171	222	254	0	235	164	126	0	0
29	99	.....	79	171	214	254	31	214	150	120	0	0
30	58	.....	82	171	214	254	70	214	164	126	0	0
31	28	.....	89	.....	214	.....	144	214	.....	126	0	0

NOTE.—These discharges are based on a rating curve that is well defined below 270 second-feet.

Monthly discharge of Central Oregon canal near Bend, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	99	0	9.8	653	A.
February	99	0	38.6	2,140	A.
March	99	31	73.2	4,500	A.
April	171	89	132	7,860	A.
May	230	171	206	12,700	A.
June	262	41	205	12,200	A.
July	283	0	157	9,650	B.
August	270	181	243	14,900	A.
September	214	150	180	10,700	A.
October	157	115	125	7,690	A.
November	126	0	21.9	1,300	B.
December	84	0	9.1	560	B.
The year	283	0	118	84,800	

Daily gage heights, in feet, of Pilot Butte canal near Bend, Oreg., for 1909.

[Deschutes Irrigation & Power Co., observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.05	2.05	2.15	2.4	2.75	2.85	2.38	2.6	2.4	1.2	.....
2	.....	1.02	2.05	2.15	2.4	2.75	2.9	2.55	2.6	2.35	1.12	.....
3	.....	.....	2.05	2.15	2.4	2.75	2.9	2.6	2.6	2.35	1.25	.....
4	1.9	.....	2.05	2.15	2.55	2.75	2.9	2.65	2.55	2.35	1.3	.....
5	.85	.....	2.05	2.15	2.55	2.75	2.92	2.88	2.55	2.35	1.3	.....
6	.....	.....	2.05	2.15	2.55	2.75	2.95	2.8	2.55	2.05	1.48	.....
7	.....	.....	2.05	2.15	2.55	2.75	2.95	2.88	2.55	2.15	1.55	.....
8	.....	.....	2.05	2.2	2.55	2.75	2.95	2.9	2.55	2.35	1.55	.....
9	.....	.....	2.05	2.25	2.55	2.75	2.95	2.88	2.55	2.35	.18	.....
10	.....	.....	2.05	2.25	2.55	2.75	2.9	2.9	2.55	2.35	.....	.....
11	.....	.....	2.05	2.3	2.55	2.75	2.95	2.88	2.55	2.35	.8	.....
12	.....	.....	2.05	2.3	2.55	2.75	2.95	2.9	2.55	2.35	1.85	0.65
13	.....	1.02	2.05	2.3	2.55	2.78	2.95	2.9	2.55	2.35	2.1	1.3
14	.....	1.02	2.05	2.3	2.55	2.8	2.95	2.9	2.55	2.38	1.1	.95
15	.....	.....	2.05	2.3	2.7	2.8	2.95	2.9	2.52	2.4	.....	.....
16	.....	.....	2.05	2.3	2.7	2.8	2.95	2.9	2.5	2.4	.....	.....
17	.....	2.05	2.05	2.3	2.7	2.8	2.95	2.9	2.5	2.4	1.7	.....
18	.....	2.05	2.05	2.3	2.7	2.65	2.95	2.9	2.5	2.4	1.6	.....
19	.....	2.05	1.8	2.3	2.7	2.8	.....	2.9	2.5	2.35	1.9	.....
20	.....	.....	1.8	2.3	2.7	2.8	.....	2.88	2.5	2.38	1.1	.....
21	.....	.....	1.72	2.3	2.7	2.8	.....	2.9	2.5	2.3	.....	.....
22	.....	.9	1.65	2.35	2.7	2.8	.....	2.9	2.5	2.25	.....	.....
23	.....	2.05	1.65	2.4	2.7	2.8	.....	2.9	2.5	2.25	1.05	.....
24	.....	2.05	1.52	2.4	2.7	2.7	.....	2.9	2.5	2.25	2.1	.....
25	.....	2.05	1.72	2.4	2.7	2.75	.....	2.85	2.48	2.25	2.1	.....
26	.....	2.05	2.05	2.4	2.75	2.8	.....	2.85	2.5	2.25	.65	.....
27	.....	2.05	2.15	2.4	2.75	2.8	.....	2.75	2.5	2.25	.....	.....
28	.....	2.05	2.08	2.4	2.75	2.8	.....	2.4	2.38	2.25	.65	.....
29	.....	.....	2	2.4	2.75	2.8	1.88	2.6	2.42	2.22	1.3	.....
30	.....	.....	2	2.4	2.75	2.8	2.12	2.6	2.45	.....	1.3	.....
31	.....	.....	2.08	.....	2.75	.....	2.3	2.6	.....	.07	.....	1.85

NOTE.—Washout in flume July 19 to 28. The canal was dry on days when the gage was not recorded.

Daily discharge, in second-feet, of Pilot Butte canal near Bend, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	0	59	59	72	110	174	192	107	145	110	7.2	0
2	0	4.3	59	72	110	174	202	136	145	102	5.8	0
3	0	0	59	72	110	174	202	145	145	102	8.2	0
4	42	0	59	72	136	174	202	154	136	102	9.1	0
5	2.5	0	59	72	136	174	206	198	136	102	9.1	0
6	0	0	59	72	136	174	212	183	136	59	15	0
7	0	0	59	72	136	174	212	198	136	72	18	0
8	0	0	59	79	136	174	212	202	136	102	18	0
9	0	0	59	86	136	174	212	198	136	102	1.9	0
10	0	0	59	86	136	174	202	202	136	102	0	0
11	0	0	59	94	136	174	212	198	136	102	2.0	0
12	0	0	59	94	136	174	212	202	136	102	38.0	1.3
13	0	4.3	59	94	136	179	212	202	136	102	65	9.1
14	0	4.3	59	94	136	183	212	202	136	107	5.5	3.5
15	0	0	59	94	164	183	212	202	131	110	0	0
16	0	0	59	94	164	183	212	202	127	110	0	0
17	0	59	59	94	164	183	212	202	127	110	26	0
18	0	59	59	94	164	154	212	202	127	110	20	0
19	0	59	34	94	164	183	0	202	127	102	42	0
20	0	0	34	94	164	183	0	198	127	107	5.5	0
21	0	0	28	94	164	183	0	202	127	94	0	0
22	0	3.0	23	102	164	183	0	202	127	86	0	0
23	0	59	23	110	164	183	0	202	127	86	4.8	0
24	0	59	17	110	164	164	0	202	127	86	65	0
25	0	59	28	110	164	174	0	192	124	86	65	0
26	0	59	59	110	174	183	0	192	127	86	1.3	0
27	0	59	72	110	174	183	0	174	127	86	0	0
28	0	59	63	110	174	183	0	110	107	86	1.3	0
29	0	.....	53	110	174	183	40	145	113	82	9.1	0
30	0	.....	53	110	174	183	68	145	118	0	9.1	0
31	.....	.....	63	.....	174	.....	94	145	.....	1.5	.....	3.8

NOTE.—These discharges are based on a rating curve that is well defined between 34 and 200 second-feet.

Monthly discharge of Pilot Butte canal near Bend, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
January	42	0	1.4	88	D.
February	59	0	21.6	1,200	C.
March	72	17	52.0	3,200	B.
April	110	72	92.4	5,500	B.
May	174	110	151	9,280	B.
June	183	154	177	10,500	B.
July	212	0	127	7,810	C.
August	202	107	182	11,200	B.
September	145	107	131	7,800	B.
October	110	0	90.2	5,550	B.
November	65	0	15.1	898	D.
December	38	0	1.68	103	D.
The year	212	0	86.9	63,100	

WIMER CANAL NEAR LAIDLAW, OREG.

The Wimer canal diverts water from Tumalo creek about three-fourths of a mile above the head gate of the Columbia Southern canal. The station was established June 16, 1906, just below the head gate of the canal and above the wasteway. It is maintained during the irrigation season only. The quantities shown during 1906–7 represent the amount diverted from the river. A part of this was returned through the wasteway which enters Tumalo Creek above the head gate of the Columbia Southern canal. On April 1, 1908, the station was moved to a point below the wasteway, and the records for that year show the net amount diverted for irrigation. The water is turned out of the canal during freezing weather.

Discharge measurements of Wimer canal near Laidlaw, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	R. B. Post	9	5.8	0.89	11
May 28	do	4	4.4	1.10	16
Aug. 1	do	4	6.4	1.60	31

Daily gage height, in feet, of Wimer canal near Laidlaw, Oreg., for 1909.

[C. A. Reeves, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	0.90	1.12	1.55	1.60	1.25	1.29	16	.....	1.02	1.15	1.60	1.60	1.21	1.29
2	.....	.90	1.12	1.56	1.60	1.32	.....	17	.....	1.02	1.14	1.55	1.60	1.22	1.29
3	.....	.91	1.18	1.59	1.60	1.29	1 28	18	.....	1.02	1.10	1.45	1.60	1.21	1.30
4	.....	.92	1.18	1.59	1.60	1.28	1.28	19	1.00	1.05	1.10	1.35	1.60	1.20	1.30
5	.....	.93	1.17	1.59	1.60	1.25	1.28	20	1.00	1.05	1.20	1.60	1.60	1.21	1.30
6	.....	.....	1.15	1.51	1.60	1.26	1.30	21	.82	1.05	1.20	1.70	1.60	1.21	1.30
7	.....	.....	1.12	1.50	1.58	1.25	1.28	22	.85	1.06	1.20	1.70	1.59	.....	1.30
8	.....	.....	1.11	1.35	1.59	1.25	1.29	23	.85	1.05	1.25	1.70	1.58	1.25	1.30
9	.....	.....	1.10	1.40	1.60	1.24	1.29	24	.85	1.06	1.21	1.70	1.58	1.25	1.30
10	.....	1.00	1.11	1.60	1.60	1.28	1.29	25	.85	1.08	1.20	1.70	1.58	1.25	1.30
11	.....	1.02	1.11	1.60	1.61	1.21	1.29	26	.88	1.10	1.21	1.68	1.60	1.28	1.30
12	.....	1.05	1.11	1.60	1.60	1.20	1.30	27	.90	1.10	1.20	1.68	1.60	1.28	1.30
13	.....	1.02	1.11	1.60	1.60	1.21	1.29	28	.89	1.98	1.18	1.67	1.59	1.28	1.30
14	.....	1.05	1.11	1.60	1.60	1.20	1.29	29	.89	1.10	1.55	1.65	1.25	1.29	1.30
15	.....	1.02	1.16	1.58	1.60	1.21	1.29	30	.89	1.12	1.55	1.70	1.25	1.29	1.30
								31	.....	1.12	.....	1.67	1.25	.....	1.30

NOTE.—Water turned out of canal May 6 to 9 and canal cleaned.

Daily discharge, in second-feet, of Wimer canal near Laidlaw, Oreg., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	10.9	16.4	29.3	31.0	20.0	21.1	16	.....	13.8	17.2	31.0	31.0	18.9	21.1
2	.....	10.9	16.4	29.6	31.0	22.0	[a]21.0	17	.....	13.8	17.0	29.3	31.0	19.2	21.1
3	.....	11.1	18.1	30.7	31.0	21.1	20.8	18	.....	13.8	15.9	26.0	31.0	18.9	21.4
4	.....	11.4	18.1	30.7	31.0	20.8	20.8	19	13.3	14.6	15.9	22.9	31.0	18.6	21.4
5	.....	11.6	17.8	30.7	31.0	20.0	20.8	20	13.3	14.6	18.6	31.0	31.0	18.9	21.4
6	.....	0	17.2	27.9	31.0	20.3	21.4	21	9.1	14.6	18.6	34.4	31.0	18.9	21.4
7	.....	0	16.4	27.6	30.3	20.0	20.8	22	9.8	14.9	18.6	34.4	30.7	[a]20.6	21.4
8	.....	0	16.2	22.9	30.7	20.0	21.1	23	9.8	14.6	20.0	34.4	30.3	20.0	21.4
9	.....	0	15.9	24.4	31.0	19.7	21.1	24	9.8	14.9	18.9	34.4	30.3	20.0	21.4
10	.....	13.3	16.2	31.0	31.0	20.8	21.1	25	9.8	15.4	18.6	34.4	30.3	20.0	21.4
11	.....	13.8	16.2	31.0	31.3	18.9	21.1	26	10.5	15.9	18.9	33.7	31.0	20.8	21.4
12	.....	14.6	16.2	31.0	31.0	18.6	21.4	27	10.9	15.9	18.6	33.7	31.0	20.8	21.4
13	.....	13.8	16.2	31.0	31.0	18.9	21.1	28	10.7	[a]15.4	18.1	33.4	30.7	20.8	21.4
14	.....	14.6	16.2	31.0	31.0	18.6	21.1	29	10.7	15.9	29.3	32.7	20.0	21.1	21.4
15	.....	13.8	17.5	30.3	31.0	18.9	21.1	30	10.7	16.4	29.3	34.4	20.0	21.1	21.4
								31	.....	16.4	.....	33.4	20.0	.....	21.4

[a] Discharge interpolated.

Monthly discharge of Wimer canal near Laidlaw, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 19–30	13.3	9.1	10.7	255	A.
May	16.4	0	12.3	756	B.
June	29.3	15.9	18.2	1,080	A.
July	34.4	22.9	30.7	1,890	A.
August	31.3	20.0	29.8	1,830	A.
September	22.0	18.6	19.9	1,180	A.
October	21.4	20.8	21.2	1,300	A.
The period	.....	.....	.....	8,290	

COLUMBIA SOUTHERN CANAL NEAR LAIDLAW, OREG.

This station was established May 15, 1906. It is located in a flume 200 yards below the head gate of the canal. The canal was constructed by the Columbia Southern Irrigation Co. for the irrigation of about 27,000 acres of land to be reclaimed under the provisions of the Carey Act. The records of gage heights are furnished without cost to the Survey by the company.

The results obtained are of great value to the State, the company, and to the settlers on the project. The conditions are favorable for good results and the data so far obtained are reliable. The station is maintained during the irrigating season only.

The water is turned out of the canal during freezing weather.

Discharge measurements of Columbia Southern canal near Laidlaw, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq.-ft.*	*Feet.*	*Sec.-ft.*
Apr. 19	R. B. Post	19	30	1.55	46
May 28	.....do	20	42	2.10	104
Aug. 1	.....do	19.3	35.6	1.84	72.5

Daily gage height, in feet, of Columbia Southern canal near Laidlaw, Oreg., for 1909.

[C. A. Reeves, observer.]

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	1.75	2.10	2.20	1.84	1.64	1.60	16	1.69	1.95	2.10	2.15	1.61	1.61	1.55
2	.....	1.75	2.10	2.17	1.80	1.75	.....	17	1.65	1.95	2.10	2.15	1.62	1.62	1.55
3	.....	1.75	2.10	2.20	1.80	1.74	1.60	18	1.60	2.00	2.10	2.08	1.62	1.61	1.57
4	.....	1.85	2.10	2.20	1.78	1.71	1.58	19	1.55	2.10	2.10	2.03	1.62	1.61	1.60
5	.....	1.85	2.10	2.20	1.70	1.70	1.59	20	1.55	2.07	2.10	1.93	1.64	1.60	1.60
6	0.65	1.85	2.10	2.15	1.67	1.68	1.65	21	1.60	2.06	2.10	2.00	1.62	1.62	1.60
7	.65	1.85	2.10	2.18	1.65	1.65	.....	22	1.65	2.07	2.10	1.98	1.58	.....	1.60
8	.65	1.90	2.10	2.15	1.65	1.65	1.55	23	1.67	2.06	2.10	2.20	1.58	1.60	1.58
9	1.10	1.90	2.10	2.15	1.71	1.64	1.65	24	1.65	2.10	2.10	2.15	1.56	1.60	1.57
10	1.40	1.90	2.10	2.15	1.68	1.66	1.56	25	1.65	2.10	2.10	2.18	1.57	1.61	1.56
11	1.10	1.90	2.15	2.15	1.68	1.62	1.57	26	1.75	2.10	2.10	2.00	1.65	1.62	1.56
12	1.10	1.90	2.15	2.15	1.65	1.62	1.56	27	1.75	2.10	2.10	1.85	1.64	1.60	1.58
13	1.54	1.90	2.15	2.15	1.66	1.61	1.55	28	1.75	2.10	2.13	1.85	1.57	1.60	1.57
14	1.66	1.95	2.18	2.15	1.65	1.61	1.55	29	1.75	2.10	2.15	1.95	1.65	1.63	1.59
15	1.69	1.95	2.18	2.15	1.63	1.63	1.55	30	1.75	2.10	2.12	2.00	1.65	1.65	1.56
								31	.....	2.10	.....	1.86	1.64	.....	1.57

Daily discharge, in second-feet, of Columbia Southern canal near Laidlaw, Oreg., for 1909.

Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Day.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	.....	64	104	117	73	54	50	16	58	86	104	110	51	51	46
2	.....	64	104	113	69	64	50	17	54	86	104	110	52	52	46
3	.....	64	104	117	69	63	50	18	50	92	104	101	52	51	48
4	.....	74	104	117	67	60	48	19	46	104	104	96	52	51	50
5	.....	74	104	117	59	59	49	20	46	100	104	84	54	50	50
6	2	74	104	110	56	57	54	21	50	99	104	92	52	52	50
7	2	74	104	114	54	54	50	22	54	100	104	90	48	51	50
8	2	80	104	110	54	54	46	23	56	99	104	117	48	50	48
9	16	80	104	110	60	54	54	24	54	104	104	110	47	50	48
10	34	80	104	110	57	55	47	25	54	104	104	114	48	51	47
11	16	80	110	110	57	52	48	26	64	104	104	92	54	52	47
12	16	80	110	110	54	52	47	27	64	104	104	74	54	50	48
13	46	80	110	110	55	51	46	28	64	104	108	74	48	50	48
14	55	86	114	110	54	51	46	29	64	104	110	86	54	53	49
15	58	86	114	110	53	53	46	30	64	104	107	92	54	54	47
								31	.....	104	.....	76	54	.....	48

NOTE.—These discharges are based on a rating curve well defined between 35 and 110 second-feet. Discharge interpolated for days having no gage height record.

Monthly discharge of Columbia Southern canal near Laidlaw, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off (total in acre-feet).	Accuracy.
	Maximum.	Minimum.	Mean.		
April 6–30	64	2	43.6	2,160	A.
May	104	64	88.3	5,430	A.
June	114	104	106	6,310	A.
July	117	74	103	6,330	A.
August	73	47	55.3	3,400	A.
September	64	50	53.4	3,180	A.
October	54	46	48.4	2,980	A.
The period	.....	.....	.....	29,800	

KLICKITAT RIVER DRAINAGE BASIN.

DESCRIPTION.

Klickitat River drains the eastern slope of the southern portion of the Cascade Range in Washington. Its position is similar to that of Deschutes River in Oregon, except that the two streams flow in opposite directions. Both empty into Columbia River a short distance east of the divide.

Klickitat River rises in Goat Mountain, at an elevation of 8,500 feet above the sea, flows generally southward, paralleling the main range of the Cascades, and empties into Columbia River near the town of Lyle. The total length of the main stream is 105 miles. The principal tributaries, named in their order downstream, are, from the west, McCreedy Creek, West Fork, Cunningham Creek, Big Muddy River, Bacon Creek, and Outlet Creek; from the east, Diamond Fork,[1] Piscoe Creek, Surveyors Creek, White Creek, Little Klickitat River, and Swale Creek. The total drainage area is 1,160 square miles, distributed as follows:

Area of Klickitat River drainage basin.

	Square miles.
Below the mouth of Diamond Fork	85
Below the mouth of West Fork	254
Below the mouth of Big Muddy River	347
Below the mouth of Little Klickitat River	995
Diamond Fork	43
West Fork	92
Big Muddy River	33
Outlet Creek	87
Little Klickitat River	285

The most prominent feature of the area is Mount Adams, which crowns the summit of the divide at an elevation of 12,307 feet. The glaciers on this peak cover 2,300 acres. Those to the east supply the water in Big Muddy River and Little Muddy Creek during the summer months.

The region has been the scene of pronounced volcanic activity and its general topography is in consequence abrupt and rugged. The streams as a rule flow in deep canyons cut into the basalt and lavas. Near the summit of the divide and the spurs that extend from it are a number of grassy meadows bordered by low benches of level or gently rolling land. Many of the meadows are swampy during wet seasons, and lakes occupy the deeper depressions. From the summit of the range eastward the steep slopes of the mountains give way to high, rolling table-lands, into which the streams have cut

[1] Diamond Fork is locally known as Little Klickitat. It should not be confused with Little Klickitat River, the largest eastern tributary.

deeply. The canyon walls are very steep and angular and in places 2,000 feet high. For the most part the rivers occupy the entire floors of the canyons, although on the inside of bends there is usually a flood plain 100 to 500 feet in width.

The soil of the area has resulted from the disintegration of the lavas and basalts. Some of the lavas are very porous, having the appearance of sponge, and in places considerable scoria and pumice are found. The rocks produce a coarse, porous soil that absorbs large quantities of water and readily delivers it to the ground rocks. Thus the ground-storage capacity of the area is relatively high. The result is that the streams have a fairly uniform flow and maintain a good discharge during the summer months. This natural tendency is further augmented by additional waters supplied by the glaciers on Mount Adams and the snow banks that stand in favored spots well into the summer.

The entire area, except the extreme eastern portion, is more or less covered with timber. On the west side of the river the growth is heavy, but it gradually thins out toward the eastern boundary of the basin. Only 4 per cent of the total area lies within the Columbia National Forest. In this portion about 80 per cent is heavily timbered and 18 per cent has been burned over. Of the entire area about 75 per cent is timbered, but the stand on over half of this is less than 2,000 feet board measure per acre. In the national forest about 55 per cent of the timber is yellow pine. Red or yellow fir constitutes 20 per cent of the stand, tamarack 10 per cent, white pine 5 per cent, mountain hemlock 5 per cent, and all other species 5 per cent. Over the entire area yellow pine is the predominating species. The sides and bottoms of the canyons are studded with patches of scrub oak in the lower portions, and cottonwoods and alders grow profusely near the water's edge.

Only a small part of the land suitable for agriculture is cultivated. In the vicinity of Glenwood an important amount of hay is cut from the moist table-lands. Irrigation is practiced to some extent on these lands. Hay and the hardier vegetables constitute the principal crops. Wheat is raised in considerable quantities on the high lands in the eastern portion of the drainage area. Irrigation is practiced also on the lower stretches of the river, but the irrigated tracts are small and lie in narrow strips along the river bank in the bottom of the canyon. About 3 miles below Little Klickitat there is a garden and strawberry patch of about 3 acres, which produces abundantly under irrigation.

The only railroad in the area is the Goldendale branch of the Spokane, Portland & Seattle Railway (the "north bank" route). This branch runs from Lyle, on the main line, to Goldendale, near the southeastern border of the State. It follows the river canyon for 17 miles, crossing the river twice in that distance. It leaves the river a

short distance above Klickitat and follows Swale Creek Canyon to the uplands. A county road from Goldendale to Glenwood crosses the river near the mouth of Dead Canyon. Between Klickitat and Parrotts Bridge the canyon is without trails and is well-nigh impassable. From Parrotts Bridge to the source a trail follows the river or the bench lands bordering it. There are also trails along the ridges, but they are almost impassable during the winter months except on snowshoes.

There are a number of mineral springs in the area. Rest Soda Springs is a famous camping resort to which a road has been built down the canyon from the Goldendale-Glenwood road. A ferry was also installed by popular subscription. The soda springs below West Fork furnish an abundance of mineral water fully equal to the water of the famous Shasta Springs in California. Below McCormick Meadows is another soda spring of excellent quality. The water issues from seams in the bedrock.

So far as known the area contains no very large reservoir sites. Many small ones, however, could be developed in the swamps and lakes of the upland benches. The best sites are found on Fish Lake Stream, a tributary of West Fork. Fish Lake, Howard Lake, and Two Lakes could probably be developed to a moderate extent. The grade of Fish Lake Stream is comparatively flat and detailed investigation would probably discover good storage sites. Near the headwaters of Hellroaring Creek there is a favorable site for storage. The waters of this stream are largely supplied from Mazama Glacier. About a mile below the glacier the stream spreads in two branches through a comparatively flat meadow. The south branch has a good dam site at the east end of the meadow, where a dam 100 feet high could be constructed. The north branch falls over the escarpment, dropping over 200 feet in one-fourth mile. It is likely that considerable storage could be developed at McCormick Meadows on the main stream, 5 miles by trail above the mouth of Diamond Fork. There is little doubt that all these reservoirs would be filled every season.

On account of the fairly steep grade, well-maintained flow, and rocky canyons through which Klickitat River and its tributaries flow, the system offers some exceptionally favorable opportunities for power development. At present, however, there are no such developments in the drainage area, although several water filings have been made for power and irrigation.

West Fork and Big Muddy River offer some favorable opportunities for high-head developments. The streams flowing directly from Mount Adams, are almost literally "on end," and there are numerous falls which could readily be utilized for power development. Below the mouth of Hellroaring Creek, Big Muddy River enters a

box canyon, in places not over 6 feet wide, cut into the basalt. The total fall in the last 3½ miles is 968 feet. Above the mouth of Hellroaring Creek this stream falls 1,300 feet in 4 miles over large bowlders that fill the river bed. The bed of Hellroaring Creek is similarly strewn with bowlders, and the waters fall nearly 2,000 feet in 5¼ miles. One-half mile above the mouth of West Fork there are falls 15 feet in height. Another drop of about the same height occurs three-fourths of a mile below the mouth of Little Muddy Creek and there are several falls on Fish Lake Stream, a short distance above its mouth. The grade of the main Klickitat is fairly uniform, averaging 44.5 feet to the mile for the 73 miles surveyed. The fall gradually decreases from 63 feet to the mile below Diamond Fork to 20 feet to the mile at the head of the box canyon. This box canyon continues from a point about half a mile above the lower railroad bridge to the mouth of the river, but the lower 1½ miles are subject to backwater from Columbia River. The canyon has been cut in the solid basalt, and in places is not over 10 feet in width, with perpendicular sides of jagged rock. The total fall here is 75 feet in three-fourths of a mile. Favorable sites for dams are numerous on the main stream, and the benches along the river in some places render construction of open canals entirely feasible. On the steep canyon sides, however, water would be more safely carried in large pressure pipes. During warm weather the waters, particularly those from Mount Adams, carry considerable glacial silt which would cut machinery badly.

During the summer of 1909 the United States Geological Survey made a water-power survey of this basin.[1] Discharge measurements were made on all important tributaries and of the main river at various points. The stream-flow data obtained during this investigation are included in the present report.

KLICKITAT RIVER ABOVE AND BELOW BIG MUDDY RIVER, NEAR KLICKITAT, WASH.

From October, 1904, to June 26, 1908, the Klickitat Irrigation & Power Co. made a series of measurements on Big Muddy River and Klickitat River above and below the mouth of the Big Muddy. Through the courtesy of the company the results are presented here as furnished, except that, following the rule of the Geological Survey, discharge data are given only to three significant figures. They were computed to hundredths of a second-foot by the company. No gage heights were recorded.

[1] For the results of this investigation including profiles of the rivers surveyed, see Stevens, J. C., Water powers of the Cascade Range, Part I, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

Discharge measurements on Klickitat River 1,000 feet above the mouth of Big Muddy River near Klickitat, Wash., in 1905.

[By Klickitat Irrigation & Power Co.]

	Sec. ft.		Sec. ft.
June 19	717	Aug. 11	377
June 29	655	Aug. 18	360
July 8	574	Sept. 2	312
July 15	465	Sept. 15	342
July 22	426		

Discharge measurements of Klickitat River below mouth of Big Muddy River near Klickitat, Wash., in 1905, 1907–8.

[By Klickitat Irrigation & Power Co.]

Date.	Locality.	Discharge.	Date.	Locality.	Discharge.
1905.		*Second-feet.*	1908.		*Second-feet.*
June 5	At Parrott's bridge[a]	1,490	Apr. 3	At Camp Klickitat	1,000
12	do	1,590	7	do	912
19	do	1,210	10	do	1,180
28	At Robertson's ranch[b]	989	14	do	1,770
July 8	do	879	18	do	3,050
15	do	764	21	do	3,270
22	do	955	24	do	2,700
Aug. 12	do	668	28	do	1,940
19	do	662	May 1	do	2,270
Sept. 1	do	538	5	do	2,190
15	do	545	8	do	2,510
1907.			12	do	1,980
July 9	At Camp Klickitat[c]	1,190	16	do	1,850
16	do	1,080	19	do	1,830
22	do	950	23	do	1,960
29	do	884	26	do	2,070
Aug. 5	do	824	29	do	2,200
12	do	695	June 2	do	1,940
19	do	753	5	do	1,950
1908.			9	do	2,850
Mar. 24	At Camp Klickitat[c]	1,250	12	do	3,010
27	do	1,150	16	do	2,570
30	do	1,060	19	do	2,050
			23	do	1,600
			26	do	1,950

[a] SE. ¼ sec. 25, T. 7 N., R. 12 E.
[b] SW. ¼ sec. 11, T. 7 N., R. 12 E.
[c] NE. ¼ sec. 10, T. 7 N., R. 12 E.

In 1908 and 1909 William R. King, chief engineer of the Klickitat Valley Development Co., made some discharge measurements and had gage readings taken to determine the discharge at the lowest stage during the winter of 1908–9. The results are published here through the courtesy of Mr. King.

The discharge measurements were made with a Lallie meter, the rating table furnished by the manufacturers being used. Later this meter was rated at the United States Geological Survey rating station at Chevy Chase, Md., and it was found that the manufacturer's table gave velocities nearly 17 per cent too low. The original notes of Mr. King have therefore been recomputed, and a revision of his first estimates is given below.

The first gage established by Mr. King was near the Camp Klickitat gaging bridge of the Klickitat Irrigation & Power Co., in the NE. ¼ sec. 10, T. 7 N., R. 12 E., and the measurements were made from the

bridge. The results are therefore comparable with those obtained by that company.

Two measurements were made at this point and gage heights were observed during September and October, 1908. From these the table of discharges has been computed.

Discharge measurements of Klickitat River at Camp Klickitat, Wash., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 13	W. R. King	82	200	1.30	780
Oct. 23	do	79	177	1.08	619
1909.					
Aug. 9 [a]	H. D. McGlashan	84	198	[b] .55	732
Sept. 3 [a]	do	83	191	[b] 47	738

[a] This measurement was made during the water-power survey made in the summer of 1909.
[b] Gage height on old gage at gaging bridge.

Daily gage height, in feet, and discharge, in second-feet, of Klickitat River at Camp Klickitat, Wash., for 1908.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
Sept. 13	1.3	790	Oct. 4	1.0	560
Sept. 18	1.0	560	Oct. 7	1.0	560
Sept. 19	1.0	560	Oct. 11	1.0	560
Sept. 21	1.1	635	Oct. 13	1.4	870
Sept. 23	1.0	560	Oct. 17	1.2	710
Sept. 25	1.0	560	Oct. 19	1.3	790
Sept. 28	1.0	560	Oct. 23	1.2	710
Oct. 1	1.1	635	Oct. 25	1.1	635

KLICKITAT RIVER AT HANSON'S CABLE, NEAR KLICKITAT, WASH.

The second gage installed by Mr. King was at Hanson's cable, a short distance below the mouth of Outlet Creek. This gage was read during the fall and winter of 1908–9, and probably represents as severe low-water conditions during the winter as will be encountered.

Discharge measurements of Klickitat River at Hanson's cable, near Klickitat, Wash., in 1908.

[By W. R. King.]

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Square feet.*	*Feet.*	*Second-feet.*
Oct. 24	W. R. King	102	237	2.00	808
Oct. 30	do	103	273	2.28	1,050

Daily gage height, in feet, and discharge, in second-feet, of Klickitat River at Hanson's cable, near Klickitat, Wash., for 1908–9.

Day.	1908						1909			
	October.		November.		December.		January.		February.	
	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.	Gage height.	Discharge.
1			2.2	970	2.1	890			2.5	1,250
2							1.9	670		
3			2.1	890	2.1	890			2.5	1,250
4							2.1	890		
5			2.1	890	2.0	810			2.4	1,150
6							1.9	740		
7			2.1	890	2.1	890				
8							1.9	740		
9			2.1	890	2.1	890				
10							1.8	670		
11			2.0	810	2.2	970			2.3	1,060
12							1.9	740		
13			2.0	810	2.0	810				
14							1.9	740		
15			2.0	810	1.9	740			2.3	1,060
16							2.0	810		
17			2.1	890	1.9	740			3.2	2,000
18							2.3	1,060		
19			2.4	1,150	1.9	740			3.2	2,000
20							3.1	1,890		
21			2.5	1,250	1.9	740			3.0	1,780
22							2.5	1,250		
23			2.4	1,150	2.0	810			2.8	1,560
24	2.0	810					3.0	1,780		
25			2.3	1,060	2.0	810				
26							2.8	1,560		
27			2.2	970	2.2	970				
28							2.3	1,060		
29			2.2	970	2.1	890				
30	2.3	1,060					3.1	1,890		
31					2.0	810				

KLICKITAT RIVER AT WELS FERRY, NEAR LYLE, WASH.

In 1908 and 1909 daily gage heights were recorded at Wels Ferry, about 8 miles below Klickitat, and about 6 miles above Lyle, Wash., by Ham, Yearsley & Ryrie, of Spokane. These heights are published through the courtesy of that firm.

Daily gage height, in feet, of Klickitat River at Wels Ferry near Lyle, Wash., for 1908–9.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.											
1	0.7	−0.2	0.4	0.75		1.1	0.85				
2	.55	−.15	.45	.7		1.0	.85				
3	.45	−.1	.4	.7	1.2	.95	.9				
4	.4		.35	.75	1.25	.95	.8				
5	.35	.1	.35	.75	1.25	.95	.7				
6	.3	.4	.3	.7	1.3	1.0	.65				
7	.3	.2	.3	.65	1.3	1.15	.7				
8	.35	.1	.25	.6	1.25	1.35	.7				−0.4
9	.7	.3	.25	.65	1.25	1.45	.7				
10	.65	.5	.20	.7	1.2	1.6	.75				
11	.55	.45	.20	.75	1.15	1.65	.7			−0.35	
12	.5	.4	.35	.9	1.1	1.6	.7				
13	.5	.3	.45	1.05	1.05	1.5	.75				
14	.45	.2	.35	1.15	1.0	1.35	.7				
15	.35	.15	1.9	1.1	1.1	1.3	.65				

Daily gage height, in feet, of Klickitat River at Wels Ferry, near Lyle, Wash., for 1908–9—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.
1908.											
16	0.3	0.1	2.7	1.15	1.25	1.25	0.6	.....	.....	.....	.....
17	.5	.15	2.75	1.4	1.25	1.15	.55	.....	.....	.....	.....
18	.45	.2	2.45	1.85	1.2	1.05	.45	.....	.....	.....	.....
19	.55	.25	1.9	2.15	1.2	1.0	.45	.....	.....	.....	.....
20	.65	.3	1.55	2.1	1.15	.9	.45	.....	.....	.....	.....
21	.6	.25	1.35	1.9	1.1	.85	.45	.....	.....	.....	.....
22	.4	.2	1.35	1.65	1.05	.75	.4	.....	.....	.....	.....
23	.3	.2	1.3	1.6	1.0	.6	.4	.....	.....	.....	.....
24	.25	.3	1.25	1.55	1.15	.65	.4	.....	.....	.....	.....
25	.25	.3	1.25	1.45	1.2	.75	.35	.....	.....	−0.4	.....
26	.2	.35	1.2	.....	1.25	.85	.....	.....	.....	.....	.....
27	.15	.4	1.15	.....	1.25	.85	.....	.....	.....	.....	.....
28	.1	.45	1.1	.....	1.25	.8	.....	.....	.....	.....	−0.4
29	.05	.35	1.0	.....	1.25	.85	.....	.....	.....	.....	.....
30	−.1	.....	.9	.....	1.25	.85	.....	.....	.....	.....	.....
31	−.15	.....	.85	.....	1.2	.....	.....	.....	.....	.....	.....
1909.											
1	.....	.4	1.25	1.05	.95	1.6	.4	0.05	−0.15	−.25	−.15
2	.....	.65	1.3	1.0	1.0	1.85	.4	.05	−.15	−.25	.15
3	.....	.8	1.2	.95	1.15	1.8	.4	1	−.15	.....	.75
4	.....	.65	1.05	.9	1.35	1.7	.4	.1	−1.1	.....	1.15
5	.....	.75	.95	.85	1.45	1.65	.4	.1	−.1	.....	.65
6	.....	.65	.85	.75	1.35	1.4	.5	.15	−.1	.....	.5
7	.....	.55	.75	.7	1.25	1.3	.45	.15	−.15	.....	.45
8	.....	.45	.7	.7	1.15	1.2	.4	.1	−15	.....	.35
9	.....	.4	.65	.75	1.10	1.15	.4	.1	−.15	.....	.25
10	.....	.35	.65	.85	1.05	1.1	.35	.05	−.2	−.3	.1
11	.....	.25	.6	.9	1.0	1.1	.35	.05	−.2	−.3	.05
12	.....	.3	.65	1.0	.9	1.05	.35	0	−.2	−.3	0
13	.....	.4	.7	1.05	.9	1.1	.3	−.05	−.2	−.3	0
14	.....	.45	.75	1.1	.95	1.05	.3	−.05	−.2	−.3	−.15
15	.....	.55	.85	1.05	.95	1.0	.25	−.1	−.2	−.3	−.3
16	.....	.95	.9	1.0	.95	1.0	.25	−.1	−.2	−.3	−.3
17	.....	1.85	.95	1.05	1.0	1.05	.2	−.15	−.2	−.3	−.25
18	.....	2.25	1.05	1.05	1.0	1.1	.2	−.15	−.2	−.3	−.1
19	.....	1.95	.95	1.0	1.05	1.05	.2	−.2	−.25	−.3	1.45
20	.....	1.65	.9	1.05	1.1	.95	.15	−.1	−.25	−.3	1.75
21	.....	1.35	.85	.95	1.15	.9	.2	−.05	−.25	−.3	.....
22	.....	1.15	.8	.85	1.1	.8	.25	.....	−.25	−.3	.....
23	.....	1.05	.7	.85	1.05	.75	.2	.....	−.3	−.3	.....
24	.95	1.35	.75	.9	1.1	.7	.2	.....	−.3	−.3	.....
25	.85	1.45	.8	1.0	1.15	.65	.2	.....	−.3	−.3	.....
26	.7	1.45	.8	1.05	1.35	.6	.2	.....	−.25	−.3	.....
27	.65	1.1	.85	1.15	1.95	.55	.15	.....	−.25	−.3	.....
28	.5	1.05	.95	1.05	1.55	.5	.15	.....	−.25	−.3	.....
29	.35	.....	1.05	1.0	1.4	.45	.1	−.2	−.2	−.3	.....
30	.3	.....	1.15	.9	1.45	.45	.1	−.2	−.2	−.3	.....
31	.3	.....	1.15	.....	1.55	.....	.05	−.2	.....	−.25	.....

KLICKITAT RIVER AT KLICKITAT, WASH.

This station, which is located at Klickitat, Wash., 14 miles above the mouth of the river, was established July 3, 1909, to obtain data for use in connection with power and irrigation projects.

The gage is a vertical staff fastened to an oak stump on the right bank in line with the post office. Measurements are made from the Spokane, Portland & Seattle Railway bridge, three-fourths of a mile above the gage.

The banks of the stream are high and rocky and will not overflow. The bed of the stream is composed of gravel and cobblestones and is fairly permanent. There are no irrigable lands in the immediate vicinity of the station, but the waters may be diverted to higher lands bordering Columbia River. Plans for diversion and storage of water to irrigate the high table-lands that lie between Yakima and Columbia rivers, known as Horse Heaven Plateau, have been made. The construction of this canal will involve the expenditure of many millions of dollars, as a canal 119 miles long would have to be constructed before irrigable lands are reached; but the lands are exceedingly fertile and climatic conditions are favorable for intensive agriculture. The diversion point for this project would necessarily be some point in the vicinity of West Fork of Klickitat River, and considerable storage would have to be developed in order to provide a sufficient water supply.

Discharge measurements of Klickitat River at Klickitat, Wash., in 1907 and 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1907.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 6	H. D. McGlashan	86	200	2.15	959
1909.					
July 14	H. D. McGlashan	93	266	2.58	1,500

NOTE.—These measurements have been revised and supersede those published in Water-Supply Paper No. 253, p. 40.

Daily gage heights, in feet, of Klickitat River at Klickitat, Wash., for 1909.

[Mrs. M. A. Young, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	2.34	2.05	1.92	2.4	4.9	16	2.6	2.15	2.0	1.9	1.95	3.45
2	.....	2.29	2.05	1.9	3.0	4.5	17	2.5	2.18	1.98	1.9	2.1	3.32
3	2.9	2.3	2.02	1.9	3.82	4.1	18	2.48	2.18	1.92	1.88	2.88	3.2
4	2.85	2.28	2.08	1.9	3.45	3.8	19	2.45	2.22	1.92	1.92	4.11	3.14
5	2.85	2.28	2.05	1.98	2.95	3.67	20	2.45	2.22	1.92	1.95	4.12	3.08
6	2.82	2.22	2.05	1.92	2.45	3.55	21	2.45	2.18	2.02	1.95	3.42	2.75
7	2.8	2.21	2.02	1.9	1.98	3.4	22	2.5	2.08	1.98	1.92	(a)	2.75
8	2.8	2.21	2.05	1.9	1.98	3.4	23	2.5	2.1	1.92	1.9	(a)	2.7
9	2.8	2.21	2.08	1.95	2.48	3.3	24	2.5	2.08	1.92	1.9	(a)	2.72
10	2.75	2.22	2.0	1.98	2.4	3.2	25	2.42	2.08	2.0	1.9	5.4	2.8
11	2.7	2.18	1.95	1.98	2.32	3.18	26	2.38	2.2	1.95	1.9	4.7	2.75
12	2.68	2.18	1.98	1.95	2.22	3.6	27	2.36	2.12	2.0	1.88	4.25	2.72
13	2.61	2.18	2.0	1.92	2.2	4.08	28	2.38	2.05	2.0	1.9	4.4	2.65
14	2.6	2.18	2.0	1.95	2.12	3.72	29	2.38	2.05	2.0	1.9	4.85	2.58
15	2.6	2.12	2.0	1.95	1.92	3.52	30	2.39	2.05	1.95	1.88	5.5	2.62
							31	2.32	2.05	.....	1.92	.....	2.69

a Water over the gage.

Daily discharge, in second-feet, of Klickitat River at Klickitat, Wash., for 1909.

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1,200	900	778	1,270	4,730	16	1,500	1,000	850	760	805	2,600
2	.....	1,150	900	760	2,000	4,130	17	1,380	1,030	832	760	950	2,420
3	1,870	1,160	870	760	3,120	3,530	18	1,360	1,030	778	742	1,840	2,260
4	1,800	1,140	930	760	2,600	3,090	19	1,320	1,070	778	778	3,540	2,180
5	1,800	1,140	900	832	1,940	2,840	20	1,320	1,070	778	805	3,560	2,100
6	1,770	1,070	900	778	1,320	2,740	21	1,320	1,030	870	805	2,560	1,680
7	1,740	1,060	870	760	832	2,530	22	1,380	930	832	778	4,000	1,680
8	1,740	1,060	900	760	832	2,530	23	1,380	950	778	760	6,000	1,620
9	1,740	1,060	930	805	1,360	2,390	24	1,290	930	778	760	6,000	1,640
10	1,680	1,070	850	832	1,270	2,260	25	1,290	930	850	760	5,520	1,740
11	1,620	1,030	805	832	1,180	2,230	26	1,250	1,050	805	760	4,430	1,680
12	1,600	1,030	832	805	1,070	2,810	27	1,230	970	850	742	3,760	1,640
13	1,510	1,030	850	778	1,050	3,500	28	1,250	900	850	760	3,980	1,560
14	1,500	1,030	850	805	970	2,980	29	1,250	900	850	760	4,660	1,480
15	1,500	970	850	805	778	2,700	30	1,260	900	805	742	5,680	1,520
							31	1,180	900	.....	778	.....	1,610

NOTE.—These discharges are based on a rating curve that is fairly well defined between 670 and 3,400 second-feet. Discharges Nov. 22 to 24, estimated.

Monthly discharge of Klickitat River at Klickitat, Wash., for 1909.

[Drainage area, 1,090 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
July 3–31	1,870	1,180	1,480	1.36	1.47	85,100	A.
August	1,200	900	1,030	.945	1.09	63,300	A.
September	930	778	847	.777	.87	50,400	A.
October	832	742	777	.713	.82	47,800	B.
November	[a]10,000	778	2,760	2.53	2.82	164,000	B.
December	4,730	1,480	2,400	2.20	2.54	148,000	B.
The period	.....	.....	.....	.....	.....	559,000	

[a] Estimated.

BIG MUDDY RIVER ABOVE MOUTH OF COUGAR CREEK, NEAR KLICKITAT, WASH.

The following estimates of the discharge of Big Muddy River are made by taking the differences of discharges measured during 1905 above and below its mouth on the same or succeeding days. Some spring water is contributed above Robertson's ranch and Camp Klickitat. For estimates made at Parrott's Bridge, Dairy Creek should be included. The discharge of Dairy Creek August 6, 1909, was 4 second-feet.

Discharge measurements of Big Muddy River above mouth of Cougar Creek, near Klickitat, Wash., in 1908.

[By Klickitat Irrigation & Power Co.]

	Sec.-ft.		Sec.-ft.
May 5	168	June 2	193
May 8	172	June 5	194
May 13	159	June 9	311
May 16	152	June 12	304
May 19	158	June 16	327
May 23	165	June 19	258
May 26	180	June 23	207
May 29	191	June 26	251

Estimates of discharge of Big Muddy River, 1905.

	Sec.-ft.		Sec.-ft.
June 19	490	Aug. 11, 12	290
June 28, 29	343	Aug. 18, 19	302
July 8	305	Sept. 1, 2	226
July 15	300	Sept. 15	202
July 22	528		

WHITE SALMON RIVER DRAINAGE BASIN.

DESCRIPTION.

White Salmon River has its source in three glaciers on the West side of Mount Adams. The largest of these is White Salmon River Glacier. To the north of this lies Pinnacle Glacier and to the south Avalanche Glacier. The river flows southward and empties its waters into Columbia River at the town of Underwood. The source and mouth of the river lie on the same meridian. The river has a total length of 38.5 miles and a total drainage area of 352 square miles.

Trout Creek is the principal tributary. It drains the high spurs and secondary peaks to the southwest of Mount Adams, flows in a southeasterly direction, and empties into White Salmon River near Trout Lake post office. Three small creeks—Big Spring Creek from the west and Gilmer and Rattlesnake creeks from the east—empty into the river below Trout Creek in the vicinity of Husum. Gotchen Creek, the principal tributary above Trout Creek, drains the high spurs to the southeast of Mount Adams.

The drainage area of White Salmon River is distributed as follows:

Area of White Salmon River drainage basin.

	Square miles.
Above the mouth of Trout Creek	84
Below the mouth of Gilmer Creek	290
At Husum	300
At Underwood	352
Trout Creek	85

The prominent topographic feature of the area is Mount Adams and the spurs and secondary peaks that surround it. These peaks

crown the bounding lines of the drainage area, which is roughly V-shaped, with Mount Adams at the apex. On the west Steamboat Mountain (at an elevation of 4,600 feet), the Castle (5,100 feet), and Old Huckleberry (5,200 feet) stand like sentinels on the summit of the divide. South Butte (7,790 feet), Snow Plow (5,070 feet), Snipes Mountain (4,800 feet), King Mountain (4,710 feet), and Snow Mountain (3,620 feet) prominently mark the eastern boundary. The basin is therefore roughly trough shaped, with several smaller peaks within it. The topography is bold and picturesque. The streams flow in deep canyons on beds of bowlders, with here and there ledges of basalt or stretches of box canyons that have vertical, jagged sides and solid beds.

The whole drainage basin is covered with lava and basalt, in which the canyons have been carved. Near Mount Adams many cinder cones and bombs give evidence of recent volcanic activity. Red Butte, 3 miles northeast of Mount Adams, has an elevation of 7,203 feet. The cone is 500 feet high, with a crater 175 feet in diameter and 75 feet deep. Much of the pumice, scoria, and lava from these cones is highly colored, and volcanic glass is found in various shades from black masses to transparent globules. The bombs on the lower slopes of Mount Adams are rough spherical masses of lava, of homogeneous texture, ranging up to 30 feet in diameter. Near the headwaters are large areas of partly exposed lava beds. A line of caves may be traced along this formation for 20 miles or more. In some places the caves have been formed by the liquid mass flowing from under a solidified crest; in others they may have resulted from the action of gases and are in effect huge bubbles. One of these in sec. 25, T. 6 N., R. 9 E. is widely known as the Ice Cave. The temperature is so low that water accumulating and freezing during the winter does not thaw out during the following summer. The ice is found in masses on the floor and in stalactites and stalagmites formed by surface water dripping through crevices in the roof. These form during the winter and are partly melted during the summer. The area in which these caves lie is drained by Trout Creek. The basin contains several small intermittent watercourses in which the water sinks at many points. It is likely that much of the surface water finds its way deep into these lava beds, emerging into lower portions of White Salmon River or even into the adjacent drainage basin of Little White Salmon River.

The main river flows in a deep canyon whose sides are bordered by heavily rolling table-lands or mountains. From a point 3 miles below Trout Creek to a point 2½ miles above Husum the river flows in a narrow box canyon. This has been cut squarely into the basalts and the recent lava flows that have overspread them. The canyon is about 11 miles long and nearly every part of it would afford a favorable site for a dam. Trout Creek, on the other hand, is essen-

tially a surface stream below Trout Lake. The banks are bordered by fairly level stretches of open meadows and agricultural land.

The north line of T. 6 N. forms the southern boundary of the Columbia National Forest. Logging operations have been carried on for years in this drainage area, for the most part on lands adjacent to the river. The entire drainage area is heavily forested except where cleared for agriculture. Within the national forest the timbered area constitutes 73 per cent of the total, 26 per cent is burned, and 1 per cent is above timber line. The species are distributed in about the same proportion as those in the adjacent Klickitat basin, except that there is more red or yellow fir and less yellow pine. The stand of timber within the national forest is about as follows:

	cent.
0 to 2,000 feet b. m. per acre	18
2,000 to 5,000 feet b. m. per acre	30
5,000 to 10,000 feet b. m. per acre	40
10,000 to 25,000 feet b. m. per acre	8
25,000 to 50,000 feet b. m. per acre	4

There are no railroads in the drainage area except the Spokane, Portland & Seattle Railway, which crosses the river at its mouth in its course along the right bank of Columbia River. The principal towns are Underwood and White Salmon, the latter being on the high table-land east of the river near its mouth. Husum post office is at the mouth of Rattlesnake Creek. Trout Lake post office is near the mouth of Trout Creek, on the east side of the river, and Guler is on Trout Creek near the outlet of Trout Lake. Good wagon roads and stage lines connect all the towns. The upper portion of this area is a favorite summer resort, and many campers will be found around Trout Lake and Guler in the summer.

The rolling benches along the lower part of the river have been cleared for agriculture. Most of these lands are in orchards and the territory has become justly famous for the excellent quality of its apples and other fruit. In T. 6 N. the lands along the river are comparatively flat, and some of them were natural meadows. These open lands have been enlarged by clearing the timber around them, and the whole valley presents a delightful picture of prosperity. In this portion of the valley irrigation is practiced extensively. The water for the ditches is diverted from Trout Creek and White Salmon River. These ditches are small but numerous, and they have an abundant supply of water.

At present lumbering is the principal industry of this territory. The Wind River Lumber Co. has constructed several splash dams on White Salmon River by means of which logs are floated from the upper portion of the drainage area to the mouth of the river, where they are gathered and transported in rafts to the mills on the lower Columbia.

At Husum is a small power plant owned and operated by the Husum Power Co. The present capacity of the plant is 200 horsepower. It is developed by a twin turbine with 26-inch wheels, belt connected to a 75-kilowatt alternator, generating at 2,300 volts. Current is transmitted to White Salmon, 6½ miles, and up the valley 2 miles, for lighting and power. The water is supplied to the wheels by a canal 200 feet in length. The canal normally carries 120 second-feet and develops a head of 17 feet around falls in the river at this point.

So far as known the basin affords no large reservoir sites. Trout Lake is the only flat area that would be suitable, but the outlet is a broad valley, and no favorable dam sites are found. Most of the water runs off during the spring, exposing the lake bed as a marshy flat. A small amount of storage might be developed at Steamboat Lake near the headwaters of Trout Creek.

Owing to the porous lava rocks of which the area is composed and the soil resulting from its disintegration, a large amount of water is held in ground storage. Springs are numerous along the river and seepage into it is large. Most of the summer flow, however, is supplied by the glaciers on Mount Adams. Above Trout Creek, White Salmon River has its lowest discharge during cold weather, while on hot summer days the discharge is high, and the water is heavily loaded with glacial silt. Trout Creek, on the other hand, has its lowest period at the end of the summer season. During the winter months the discharge is relatively high from surface drainage from the large area through which it flows. The two streams therefore maintain a well-balanced flow during the year. Floods occur during heavy rains when accompanied by chinook winds, which suddenly melt the snow on the hills. The heaviest floods are likely to occur in the autumn after an early snowfall. A flood from this cause of greater or less magnitude may be expected about the middle of each November and at other times during the winter months. Spring floods occur periodically, but are rarely so severe as the fall floods and are not so sudden. These result from the more gradual melting of snow in the mountains as warm weather approaches. This melting is arrested at night, with the result that the stream shows daily variations of considerable magnitude.

No discharge data are available except those gathered during the course of the water power survey made by the United States Geological Survey in the summer of 1909.[1] Measurements were made at several points on the main stream and its tributaries. The stream-flow data obtained during the investigation are included in the present report.

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[1] For the results of this investigation including profiles of the rivers surveyed see Stevens, J. C., Water powers of the Cascade Range, pt. 1, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

Owing to the steep grade, well-maintained summer flow, and rocky canyons through which White Salmon River flows, opportunities for water-power developments are abundant. The average fall of the main river for that portion surveyed—32.1 miles—is 83 feet to the mile. Nine miles of the river's course above the mouth of Gilmer Creek has an average fall of 117 feet to the mile; in the last 3 miles the fall averages 53 feet to the mile. Trout Creek falls 115 feet from Trout Lake to its mouth, somewhat more than 2 miles. Where the north line of sec. 25, T. 5, R. 10, crosses White Salmon River there are two falls with a total drop of 35 feet. At Husum there is a drop of 15 feet, and at a point 4 miles above the boundary of the national forest there is a drop of 5 feet.

The Wind River Lumber Co. has splash dams for floating logs in sec. 14, T. 6, R. 10; sec. 6, T. 5, R. 11; and sec. 14, T. 3, R. 10. The waters of the river are used extensively for this purpose, and doubtless certain water rights have attached.

WHITE SALMON RIVER AT HUSUM, WASH.

This station, which is located 1,200 feet above the falls, 1,600 feet above the highway bridge at Husum, Wash , and is 7½ miles above the mouth of the river, was established September 23, 1909, to obtain data concerning the low-water flow of the stream.

Discharge measurements are made from the bank by means of a meter suspended on a light cable. No equipment has been installed for making measurements at high stages. Just below the station is a flume which diverts water for the Husum power plant. The gage is a vertical staff in two sections.

The following discharge measurement was made by H. D. McGlashan:

September 23, 1909: Width, 93 feet; area, 249 square feet; gage height, 3.12 feet; discharge, 621 second-feet.

Daily gage height, in feet, of White Salmon River at Husum, Wash., for 1909.

[H. M. Thompson, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	2.85	3.12	5.85	16	.....	3.03	3.15	4.12
2	.....	3.0	4.15	5.1	17	.....	3.0	3.14	4.1
3	.....	3.0	5.9	4.8	18	.....	3.0	3.95	4.06
4	.....	3.1	6.2	4.65	19	.....	3.0	6.35	4.03
5	.....	3.1	4.25	4.45	20	.....	3.05	6.8	4.02
6	.....	2.9	3.8	4.33	21	.....	3.1	4.9	4.0
7	.....	2.9	3.5	4.2	22	.....	3.0	5.25	3.9
8	.....	3.0	3.52	4.12	23	.....	3.05	7.3	3.9
9	.....	2.95	3.7	4.01	24	3.1	3.08	7.65	3.9
10	.....	3.05	3.6	3.98	25	3.1	3.06	5.9	3.88
11	.....	3.08	3.45	3.96	26	3.06	3.0	5.2	3.85
12	.....	3.0	3.3	4.16	27	3.0	2.92	4.8	3.83
13	.....	2.9	3.21	4.6	28	3.1	2.96	4.75	3.8
14	.....	2.9	3.2	4.45	29	3.05	3.12	5.25	3.75
15	.....	2.95	3.18	4.2	30	3.25	3.1	7.3	3.85
					31	.....	3.18	.....	3.85

TROUT CREEK AT GULER, WASH.

This station, which is located at Guler post office, Wash., 2 miles above the mouth of the creek, one-fourth mile below Trout Lake and above all diversions for irrigation, was established September 16, 1909, to obtain data concerning low-water stages.

The gage is on the left bank 500 feet below the highway bridge on the meridian line between secs. 22 and 23, T. 16 N., R. 10 E. The lower section is inclined and reads to 3 feet. The upper section is vertical and reads from 3 feet to 11.5 feet. At low water the measurements are made by wading, and from the highway bridge during high stages. Sufficient measurements have not yet been made to fully develop a rating curve.

The following discharge measurement was made by H. D. McGlashan:

September 16, 1909: Width, 37 feet; area, 34 square feet; gage height, 1.32 feet; discharge, 47 second-feet.

Daily gage height, in feet, of Trout Creek at Guler, Wash., for 1909.

[Christian Guler, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	1.58	2.61	7.00	16	1.32	1.32	2.90	4.00
2	.....	1.41	4.10	6.41	17	1.32	1.32	3.10	4.00
3	.....	1.41	6.71	6.05	18	1.32	1.32	3.60	4.00
4	.....	1.41	6.25	5.25	19	1.34	1.39	6.00	3.76
5	.....	1.72	4.66	5.00	20	1.55	1.74	5.55	3.76
6	.....	1.74	4.32	4.75	21	1.64	1.96	5.00	3.75
7	.....	1.73	4.32	4.53	22	1.52	1.87	4.62	3.75
8	.....	1.64	4.34	4.31	23	1.45	1.75	5.30	3.73
9	.....	1.54	5.00	4.30	24	1.36	1.72	6.00	3.70
10	.....	1.46	4.72	4.30	25	1.38	1.65	7.16	3.70
11	.....	1.38	3.40	4.30	26	1.35	1.55	6.42	3.65
12	.....	1.38	2.80	4.41	27	1.32	1.55	5.15	3.63
13	.....	1.37	2.80	4.40	28	1.32	1.54	4.86	3.50
14	.....	1.36	2.75	4.34	29	1.50	1.64	5.52	3.50
15	.....	1.33	2.82	4.30	30	1.61	2.15	6.25	3.20
					31	.....	2.20	.....	3.00

Daily discharge, in second-feet, of Trout Creek at Guler, Wash., for 1909.

Day.	Sept.	Oct.	Day.	Sept.	Oct.	Day.	Sept.	Oct.
1	.....	70	11	.....	52	21	76	114
2	.....	55	12	.....	52	22	65	101
3	.....	55	13	.....	52	23	58	88
4	.....	55	14	.....	51	24	51	84
5	.....	84	15	.....	48	25	52	77
6	.....	86	16	48	48	26	50	68
7	.....	85	17	48	48	27	48	68
8	.....	76	18	48	48	28	48	67
9	.....	67	19	49	53	29	63	76
10	.....	59	20	68	86	30	73	147
						31	.....	157

LITTLE WHITE SALMON RIVER DRAINAGE BASIN.

DESCRIPTION.

Little White Salmon River drains the extreme south end of the Cascade Range in Washington. It lies between the main summit of this range and the White Salmon River drainage basin. The river rises on Old Huckleberry Mountain, at an elevation of 5,200 feet, flows almost directly south, and empties into Columbia River near the town of Cooks, 6½ miles downstream from the mouth of White Salmon River. The principal tributaries enter from the west, and in order downstream are Moss Creek, Lava Creek, and Rock Creek. The main river has a total length of 17 miles and a total drainage area of 132 square miles. The drainage area above Moss Creek is 37 square miles, and at a point below the mouth of Lava Creek 110 square miles. Lava Creek drains 72 square miles.

The general topographic features of the country are similar to those of the territory drained by White Salmon River. Old Huckleberry, the highest mountain, has no well-defined summit, but is rather an elongated ridge with projecting spurs to the north and south. The area is rough and mountainous. The stream flows in a very deep canyon with steep and rugged sides. There are benches paralleling the river several hundred feet above the water surface for a portion of its length. The immediate valley is occupied almost entirely by the stream, the flood plain being very narrow.

The forests on this area are similar to those in the Klickitat and White Salmon drainage basins, previously described, except that the stand is heavier and the species show the change from a semiarid to a humid climate.

The southern boundary of the Columbia National Forest crosses the river about 7 miles above its mouth. Within this area 93 per cent of the land is covered with forest and 7 per cent has been burned. Nearly all of the burned areas are being restocked, and the forest cover has been established. About 55 per cent of the stand of timber is red and yellow fir, 10 per cent hemlock, 10 per cent red cedar, 5 per cent white pine, 5 per cent yellow pine, and 15 per cent other species. The average stand of timber for this drainage area is over 4,000 feet board measure per acre; 24 per cent of the area has a stand of less than 2,000 feet board measure per acre, 60 per cent from 2,000 to 5,000 feet, 7 per cent from 5,000 to 10,000 feet, and 9 per cent from 10,000 to 25,000 feet.

There are no railroads in the drainage area except one which crosses the river at its mouth. A wagon road follows the main river from Cooks to the head of the stream. Agriculture is not extensively practiced, although a few small tracts, mainly on bench lands along

the river, have been cleared and planted to crops. On the right bank, 3 miles above the mouth, there is a bench containing over 600 acres. The timber on this bench has been logged and the land is now on the market at $150 an acre. The conditions are favorable for raising fruit. On the opposite side of the river is another narrow bench extending for several miles upstream. These lands would doubtless raise fruit of good quality if cleared. It is estimated that there are 30,000 acres of land in the Little White Salmon River drainage area suitable for agriculture after the timber has been removed.

The principal industry at present is lumbering. Large quantities of timber have already been cut from the area outside of the national forest. The logs removed are generally hauled by wagon down the canyon road. One mill is in operation at present 3 miles above the mouth. The sawed lumber is floated in a flume to Columbia River. During the summer of 1909 the United States Geological Survey made a water-power survey of this river and its tributaries. A river profile was made and the summer flow determined at several points.[1] The stream-flow data obtained during this survey are included in this present report. No other discharge data has been obtained on this stream by the Geological Survey prior to 1909. The river is subject to heavy floods during the fall and winter, and the summer discharge is comparatively low. During the summer months the principal source of supply is Moss Creek. Though this stream is not long, it is probably well supplied with water from underground sources. Lava Creek is an intermittent stream flowing through lava beds, and although its drainage area is comparatively large, a large proportion of the water falling upon it sinks into the ground, probably to reappear at points farther down. It is very likely that Moss Creek receives considerable water from the territory through which Lava Creek flows.

The porous texture of the lavas that cover these areas tends to vitiate any and all laws of stream discharge when expressed in terms of drainage area.

This stream affords an opportunity for a comparatively small plant under a high head. It is likely that during nine months of the year considerable power could be developed, but in the summer season the water supply is too small for a plant of large capacity. If developed, water would be diverted below the mouth of Lava Creek and carried about 6 miles along the side of the canyon in a pressure pipe. In this manner over 1,100 feet of head could be utilized.

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[1] For the results of this investigation, including profiles of the rivers surveyed, see Stevens, J. C., Water powers of the Cascade Range, pt. 1, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

LITTLE WHITE SALMON RIVER BELOW LAVA CREEK, NEAR COOKS, WASH.

From 1903 to 1906 the Portland Railway, Light & Power Co. made determinations of discharge of Little White Salmon River below Lava Creek, about 5 miles north of Cooks, Wash. A rectangular weir, 16.2 feet in length, was installed and daily records kept. Through the courtesy of the company these records are given in the following table:

Daily discharge, in second-feet, of Little White Salmon River below Lava Creek, near Cooks Wash., for 1903–1906.

Day.	Nov.	Dec.	Day.	Nov.	Dec.	Day.	Nov.	Dec.
1903.			1903.			1903.		
1	.....	(a)	11	275	278	21	278	(a)
2	.....	(a)	12	270	268	22	278	(a)
3	89	(a)	13	278	277	23	278	(a)
4	135	(a)	14	266	277	24	278	(a)
5	185	(a)	15	266	277	25	278	(a)
6	225	(a)	16	257	290	26	278	(a)
7	275	303	17	257	302	27	303	(a)
8	220	303	18	257	315	28	325	300
9	235	278	19	265	325	29	315	280
10	220	268	20	245	(a)	30	370	353
						31	.....	353

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1904.												
1	328	(a)	(a)	(a)	(a)	(a)	(a)	264	187	92	54	315
2	328	340	(a)	(a)	(a)	(a)	(a)	256	180	87	54	315
3	317	340	(a)	(a)	(a)	(a)	(a)	254	180	87	52	315
4	317	328	(a)	(a)	(a)	(a)	(a)	246	170	86	50	295
5	317	327	(a)	(a)	(a)	(a)	(a)	243	170	80	48	278
6	317	328	(a)	(a)	(a)	(a)	(a)	235	160	80	44	256
7	300	328	(a)	(a)	(a)	(a)	(a)	234	160	77	44	254
8	315	339	(a)	(a)	(a)	(a)	(a)	224	160	76	44	254
9	326	340	(a)	(a)	(a)	(a)	(a)	220	150	75	44	254
10	230	351	(a)	(a)	(a)	(a)	(a)	210	150	74	44	254
11	275	328	(a)	(a)	(a)	(a)	(a)	210	138	94	44	270
12	300	328	(a)	(a)	(a)	(a)	(a)	210	138	83	44	300
13	(a)	315	(a)	(a)	(a)	(a)	(a)	199	138	75	47	330
14	(a)	300	(a)	(a)	(a)	(a)	(a)	199	138	72	48	(a)
15	(a)	280	(a)	(a)	(a)	(a)	(a)	198	128	69	50	(a)
16	(a)	280	(a)	(a)	(a)	(a)	(a)	190	128	68	53	(a)
17	(a)	302	(a)	(a)	(a)	(a)	(a)	190	117	68	54	203
18	(a)	316	(a)	(a)	(a)	(a)	(a)	190	110	64	57	(a)
19	(a)	327	(a)	(a)	(a)	(a)	350	179	110	64	60	(a)
20	(a)	350	(a)	(a)	(a)	(a)	328	179	110	64	350	(a)
21	(a)	338	(a)	(a)	(a)	(a)	328	168	110	60	280	(a)
22	(a)	328	340	(a)	(a)	(a)	316	168	110	60	280	(a)
23	(a)	340	(a)	(a)	(a)	(a)	316	168	104	60	178	(a)
24	(a)	350	(a)	(a)	(a)	(a)	314	160	104	58	178	(a)
25	(a)	340	(a)	(a)	(a)	(a)	303	160	104	63	178	(a)
26	(a)	315	(a)	(a)	(a)	(a)	303	150	104	58	178	(a)
27	(a)	327	(a)	(a)	(a)	(a)	290	150	93	57	250	(a)
28	(a)	350	(a)	(a)	(a)	(a)	290	168	93	57	244	(a)
29	(a)	.....	(a)	350	(a)	(a)	276	168	93	56	248	(a)
30	(a)	.....	(a)	340	(a)	(a)	276	185	92	54	300	(a)
31	(a)	.....	(a)	329	(a)	.....	267	180	.....	54	.....	(a)
1905.												
1	(a)	340	(a)	.....	.....	.....	.....	.....	40	26	44	63
2	(a)	325	(a)	.....	.....	.....	.....	.....	40	26	43	67
3	(a)	327	(a)	.....	.....	.....	.....	.....	40	30	41	73
4	(a)	330	(a)	.....	.....	.....	.....	.....	37	40	40	77
5	(a)	316	(a)	.....	.....	.....	.....	.....	36	40	40	78

a Discharge more than 350 second-feet; water flowing around weir.

Daily discharge, in second-feet, of Little White Salmon River below Lava Creek, near Cooks, Wash., for 1903–1906—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1905.												
6	(a)	316	(a)						36	38	39	92
7	(a)	325	(a)						34	60	38	127
8	(a)	330	340						34	60	37	146
9	(a)	330	336						30	50	36	130
10	(a)	336	336						30	46	36	120
11	(a)	340	336						30	41	36	113
12	(a)	318	336						37	37	36	105
13	350	304	337						34	38	36	103
14	338	304	228						34	39	36	100
15	338	290	226						34	45	35	98
16	338	270	226						33	45	34	126
17	329	158	226						33	47	34	220
18	328	158	(b)						28	50	33	245
19	328	240							27	50	93	265
20	328	240						54	27	50	87	267
21	317	250						54	27	48	75	250
22	323	335						54	28	47	64	235
23	353	158						50	28	48	60	195
24	353	350						46	28	49	57	135
25	340	(a)						46	28	50	53	215
26	340	(a)						46	34	48	60	312
27	(a)	(a)						46	30	50	60	308
28	(a)	(a)						46	28	47	60	310
29	(a)							46	27	46	62	309
30	(a)							43	26	44	63	270
31	(a)							40		44		230
1906.												
1	210	(a)	(a)		290	280	242	129				
2	190	(a)	(a)	350	290	280	239	140				
3	182	(a)	(a)	320	289	279	233	138				
4	190	338	(a)	323	288	279	230	135				
5	195	328	(a)	320	287	276	227	132				
6	220	313	(a)	342	287	275	222					
7	245	300	(a)	336	285	274	218					
8	246	288	(a)	338	284	272	214					
9	250	280	(a)	350	283	271	210					
10	238	268	(a)	340	283	271	209					
11	240	264	(a)	332	282	270	207					
12	230	255	(a)	328	281	268	200					
13	237	245	(a)	320	281	270	197					
14	225	242	(a)	320	285	275	193					
15	212	240	345	320	294	283	190					
16	214	237	330	320	290	280	186					
17	220	240	315	316	284	274	180					
18	218	(a)	305	314	284	269	177					
19	210	(a)	270	311	282	267	172					
20	195	(a)	255	310	281	267	169					
21	193	(a)	260	310	280	266	166					
22	198	(a)	267	309	280	262	164					
23	350	(a)	273	309	280	260	163					
24	(a)	(a)	278	307	280	256	157					
25	(a)	(a)	289	303	280	254	152					
26	(a)	(a)	305	297	280	252	148					
27	(a)	(a)	310	294	280	248	145					
28	(a)	(a)	304	293	280	245	142					
29	(a)		303	291	280	244	140					
30	(a)		350	291	280	243	135					
31	(a)				280		130					

a Discharge greater than 350 second-feet; water flowing around weir.
b No record March 18 to August 19, 1905.

LITTLE WHITE SALMON RIVER NEAR COOKS, WASH.

This temporary station was established October 4, 1909. It is located at the fish hatchery one-half mile above the mouth of the river near Cooks, Wash. The gage is a vertical staff spiked to the right abutment of a bridge supporting an old lumber flume 200 feet below the fish hatchery. Measurements are made by wading a short distance below the gage. No permanent equipment has been installed for making measurements at high stages, as at such times the station is not beyond influences of backwater from Columbia River.

The following discharge measurement was made by H. D. McGlashan:

October 4, 1909: Width, 84 feet; area, 136 square feet; gage height, 2.09 feet; discharge, 170 second-feet.

Daily gage height, in feet, of Little White Salmon River near Cooks, Wash., for 1909.

[King Spurgeon, observer.]

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1		3.16	11	2.05		21	2.05	
2		2.90	12	2.04		22	2.07	
3		2.82	13	2.04		23	2.04	
4	2.10	2.72	14	2.02		24	2.02	
5	2.09	2.68	15	2.02		25	2.00	
6	2.08	2.58	16	2.01		26	2.00	
7	2.08	2.49	17	2.00		27	1.98	
8	2.08	2.42	18	2.00		28	1.98	
9	2.07	2.38	19	2.00		29	1.98	
10	2.06	2.54	20	2.02		30	2.04	
						31	2.08	

Daily discharge, in second-feet, of Little White Salmon River near Cooks, Wash., for 1909.

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1		249	11	164		21	164	
2			12	163		22	167	
3			13	163		23	163	
4	171		14	161		24	161	
5	170		15	161		25	158	
6	168		16	159		26	158	
7	168		17	158		27	155	
8	168		18	158		28	155	
9	167		19	158		29	155	
10	166		20	161		30	163	
						31	168	

NOTE.—These discharges are based on a rating curve not well defined.

SANDY RIVER DRAINAGE BASIN.

DESCRIPTION.

Sandy River has its source in the glaciers of Mount Hood and flows northwestward and unites with Columbia River at Troutdale. It drains the eastern slope of the Cascade Mountains at the very north-

ern extremity in Oregon. The principal tributaries are Bull Run River, which drains the Bull Run National Forest and furnishes the water supply for the city of Portland; Salmon River, the Little Sandy, and Zigzag, Camp, and Still creeks. The elevation at Bull Run post office is 647 feet above sea level; at Salmon post office, 1,000 feet; at Bull Run Lake, 3,161 feet; and at Government Camp, 3,880 feet. The summit of Zigzag Mountain is 5,014 feet in altitude and that of Mount Hood 11,225 feet. The drainage area includes 521 square miles at the mouth of the river, 228 square miles above the mouth of Bull Run, and 118 square miles above the mouth of Zigzag Creek. The drainage area of Bull Run River at the mouth is 168 square miles.

The mean annual precipitation at Bull Run is 76 inches; at Government Camp, 87 inches. It is likely, however, that the figure for Government Camp is not representative, because of the close proximity of the station to Mount Hood. A large part of the precipitation on the headwaters falls as snow. In the foothills, however, it nearly all appears as rain during the nine months from September to May. The value of the waters of this stream lies in their availability for municipal water supplies and in the water power that can be generated by them. Favorable sites for power development are numerous and the distance to an industrial center is not great. A large portion of the drainage area is heavily forested, although there are many areas from which the timber was burned a good many years ago. These areas have, however, grown up in second-growth timber and the underbrush is almost impenetrable.

As is usual with glacial streams, a protracted period of cold weather is very likely to cause lower water for a short period in winter than the natural low-water flow in the summer time.

SANDY RIVER AT SALMON, OREG.

This station was established December 12, 1907, at a highway bridge 1 mile below Salmon post office, Oreg. It is 1 mile below the mouth of Salmon River. This station furnishes data of value in connection with water-power development. The chain gage is located on the upstream side of the highway bridge from which the discharge measurements are made.

Conditions at the station are favorable for individual measurements of considerable accuracy during medium and low stages; at a high stage, however, the current is very swift and somewhat turbulent. During the summer months glacial silt is deposited, which destroys the stability of the rating at low stages.

The following discharge measurement was made by R. B. Post:

September 11, 1909: Width, 86 feet; area, 253 square feet; gage height 3.33 feet; discharge, 352 second-feet.

Daily gage height, in feet, of Sandy River at Salmon, Oreg., for 1909.

[J. T. McIntyre, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.5	4.3	5.1	5.45	5.6	6.15	3.95	3.65	3.35	3.35	5.6	6.85
2	4.4	4.4	5.35	5.2	5.65	5.9	3.9	3.6	3.4	3.3	8.6	6.05
3	4.75	4.45	5.1	4.95	5.8	5.8	3.85	3.6	3.4	3.2	7.8	5.4
4	5.2	4.45	4.95	4.85	6.2	5.6	3.85	3.55	3.35	3.2	6.4	4.95
5	4.85	4.35	4.75	4.85	5.95	5.25	3.8	3.5	3.3	3.35	5.95	4.85
6	4.65	4.3	4.7	4.8	5.55	5.15	4.15	3.5	3.3	3.7	5.45	4.85
7	4.5	4.2	4.7	4.75	5.35	5.05	4.3	3.45	3.25	3.85	5.25	4.8
8	4.35	4.2	4.75	4.75	5.25	4.95	4.3	3.45	3.25	3.4	5.15	4.75
9	4.25	4.1	4.95	4.8	5.3	4.85	4.35	3.45	3.2	3.35	5.1	4.7
10	4.2	4.1	4.8	4.8	5.4	4.8	4.35	3.5	3.35	3.35	5.2	4.6
11	4.2	4.05	4.6	4.75	5.55	4.8	4.5	3.45	3.4	3.4	5.05	5.95
12	4.15	4.05	4.55	4.8	5.4	4.75	4.3	3.45	3.55	3.4	4.9	8.6
13	4.1	4.0	4.5	4.9	5.25	4.55	4.15	3.4	3.5	3.35	4.7	7.85
14	4.05	4.1	4.5	4.85	5.2	4.5	4.1	3.4	3.45	3.3	4.5	6.3
15	4.6	4.3	4.45	4.85	5.1	4.45	4.0	3.5	3.35	3.3	4.35	5.95
16	5.4	5.6	4.45	4.9	5.1	4.45	3.95	3.5	3.3	3.25	4.2	5.45
17	6.25	6.7	4.5	4.75	5.2	4.4	3.95	3.45	3.25	3.25	4.25	5.1
18	7.5	6.75	4.65	4.5	5.1	4.35	3.85	3.45	3.2	3.25	7.0	4.95
19	8.1	5.8	4.6	4.55	5.05	4.25	3.75	3.5	3.65	3.35	9.65	4.8
20	9.45	5.35	4.55	4.6	4.95	4.25	3.55	3.45	3.9	3.85	8.9	4.7
21	8.85	5.2	4.55	4.65	4.95	4.2	3.7	3.45	3.65	3.8	8.75	4.65
22	7.8	5.1	4.5	4.65	4.9	4.15	3.8	3.4	3.5	3.6	14.1	4.5
23	6.5	5.8	4.45	4.7	4.85	4.15	3.75	3.4	3.3	3.45	10.4	4.5
24	5.7	6.4	4.45	4.65	4.95	4.1	3.7	3.45	3.25	3.35	11.0	4.35
25	5.35	6.0	4.5	4.65	5.1	4.1	3.75	3.45	3.25	3.35	7.9	4.25
26	5.2	5.2	4.6	5.15	5.35	4.1	3.85	3.65	3.25	3.3	6.65	4.15
27	4.95	5.1	4.65	7.7	5.65	4.05	3.9	3.6	3.2	3.25	6.1	4.1
28	4.8	5.0	4.55	7.0	5.7	4.0	3.9	3.35	3.2	3.35	7.65	4.0
29	4.65	.....	4.9	6.1	5.75	3.95	3.85	3.3	3.35	3.4	7.2	4.05
30	4.5	.....	5.15	5.55	5.9	3.95	3.75	3.35	3.4	3.65	7.35	4.25
31	4.35	.....	5.3	.....	6.2	.....	3.75	3.35	.....	5.65	.....	4.2

Daily discharge, in second-feet, of Sandy River at Salmon, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,220	1,030	1,840	2,260	2,470	3,290	745	542	370	370	2,470	4,560
2	1,120	1,120	2,140	1,960	2,540	2,900	710	510	395	345	8,680	3,130
3	1,460	1,170	1,840	1,680	2,750	2,750	675	510	395	300	6,540	2,200
4	1,960	1,170	1,680	1,570	3,370	2,470	675	480	370	300	3,720	1,680
5	1,570	1,080	1,460	1,570	2,980	2,020	640	450	345	370	2,980	1,570
6	1,360	1,030	1,410	1,520	2,400	1,900	902	450	345	575	2,260	1,570
7	1,220	945	1,410	1,460	2,140	1,780	1,030	422	322	675	2,020	1,520
8	1,080	945	1,460	1,460	2,020	1,680	1,030	422	322	395	1,900	1,460
9	988	860	1,680	1,520	2,080	1,570	1,080	422	300	370	1,840	1,410
10	945	860	1,520	1,520	2,200	1,520	1,080	450	370	370	1,960	1,310
11	945	820	1,310	1,460	2,400	1,520	1,220	422	395	395	1,780	2,980
12	902	820	1,260	1,520	2,200	1,460	1,030	422	480	395	1,620	8,680
13	860	780	1,220	1,620	2,020	1,260	902	395	450	370	1,410	6,660
14	820	860	1,220	1,570	1,960	1,220	860	395	422	345	1,220	3,540
15	1,310	1,030	1,170	1,570	1,840	1,170	780	450	370	345	1,080	2,980
16	2,200	2,470	1,170	1,620	1,840	1,170	745	450	345	322	945	2,260
17	3,460	4,280	1,220	1,460	1,960	1,120	745	422	322	322	988	1,840
18	5,870	4,380	1,360	1,220	1,840	1,080	675	422	300	322	4,850	1,680
19	7,280	2,750	1,310	1,260	1,780	988	608	450	542	370	11,900	1,520
20	11,200	2,140	1,260	1,310	1,680	988	480	422	710	675	9,520	1,410
21	9,380	1,960	1,260	1,360	1,680	945	575	422	542	640	9,100	1,360
22	6,540	1,840	1,220	1,360	1,620	902	640	395	450	510	31,600	1,220
23	3,900	2,750	1,170	1,410	1,570	902	608	395	345	422	14,500	1,220
24	2,610	3,720	1,170	1,360	1,680	860	575	422	322	370	16,700	1,080
25	2,140	3,050	1,220	1,360	1,840	860	608	422	322	370	6,770	988

Daily discharge, in second-feet, of Sandy River at Salmon, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
26	1,960	1,960	1,310	1,900	2,140	860	675	542	322	345	4,180	902
27	1,680	1,840	1,360	6,310	2,540	820	710	510	300	322	3,210	860
28	1,520	1,730	1,260	4,850	2,610	780	710	370	300	370	6,200	780
29	1,360	.....	1,620	3,210	2,680	745	675	345	370	395	5,250	820
30	1,220	.....	1,900	2,400	2,900	745	608	370	395	542	5,560	988
31	1,080	.....	2,080	.....	3,370	.....	608	370	.....	2,540	.....	945

NOTE.—These discharges are based on a rating curve that is fairly well defined below 2,300 second-feet.

Monthly discharge of Sandy River at Salmon, Oreg., for 1909.

Month.	Discharge in second-feet.			Run-off, total in acre-feet.	Accuracy.
	Maximum.	Minimum.	Mean.		
January	11,200	820	2,620	161,000	B.
February	4,380	780	1,760	97,800	B.
March	2,140	1,170	1,440	88,500	A.
April	6,310	1,220	1,890	112,000	B.
May	3,370	1,570	2,230	137,000	B.
June	3,290	745	1,410	83,900	A.
July	1,220	480	761	46,800	A.
August	542	345	435	26,700	B.
September	710	300	385	22,900	B.
October	2,540	300	476	29,300	B.
November	31,600	945	5,760	343,000	C.
December	8,680	780	2,100	129,000	B.
The year	31,600	300	1,770	1,280,000	

BULL RUN RIVER NEAR BULLRUN, OREG.

This station was established August 20, 1907, by the water board of the city of Portland in cooperation with the United States Geological Survey, to obtain data in regard to the water supply. A 30-mile pipe line diverts water at this point for the city of Portland. The drainage area of the stream is very densely forested and the water is exceptionally clear and pure.

The staff gage which is located just above the intake to the Portland water supply pipe line was read throughout the year, but as gage heights were affected at low stages by a temporary brush dam that was constructed for diverting water into the pipe line a Friez self-registering gage was installed July 28, 1909, at the cable site 1½ miles above the intake. Since August 1, 1909, observations of gage heights have been made from both gages. During periods of extreme flood, or during intervals when the Friez gage was not recording, gage heights have been estimated for the upper gage by means of the relation which has been established between the two gages. In this manner a continuous record has been secured.

Discharge measurements of Bull Run River near Bullrun, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
July 27	J. C. Stevens	120	190	[a] 3.28	219
Sept. 10	R. B. Post	110	130	[b] 2.91	118

[a] Staff gage read 0.95 foot. [b] Staff gage read 0.63 foot.

Daily gage height, in feet, of Bull Run River at headworks near Bullrun, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.30	1.58	3.16	3.50	2.47	3.50	0.80	0.68	0.40	0.74	4.15	4.10
2	2.56	1.66	3.25	3.00	2.60	3.10	.80	.66	.39	.60	7.70	3.45
3	3.22	1.88	3.05	2.70	3.12	2.80	.76	.65	.38	.50	6.85	2.95
4	3.70	1.80	2.92	2.40	3.28	2.50	.75	.62	.38	.46	4.60	2.60
5	3.02	1.78	2.60	2.40	2.69	2.33	.80	.60	.36	.42	3.95	2.40
6	2.62	1.76	2.35	2.40	2.34	2.12	2.60	.60	.35	2.20	3.60	2.05
7	2.38	1.68	2.12	2.30	2.18	2.00	1.95	.56	.34	1.40	3.20	1.95
8	2.08	1.60	2.90	2.25	2.05	1.90	1.50	.52	.33	1.15	3.65	1.50
9	1.90	1.58	2.70	2.25	2.30	1.86	1.30	.50	.33	1.00	3.50	2.25
10	1.80	1.56	2.50	2.27	2.30	1.81	1.45	.50	.60	.88	3.80	2.00
11	1.60	1.50	2.20	2.10	3.25	1.81	2.15	.48	.56	.78	3.40	2.50
12	1.35	1.50	2.10	2.04	2.90	1.70	1.80	.48	.45	.70	2.95	5.10
13	1.45	1.65	2.03	2.02	2.65	1.56	1.58	.48	.40	.66	2.60	4.35
14	1.40	1.75	1.98	2.00	2.45	1.50	1.40	.50	.38	.63	2.30	3.50
15	3.00	2.75	1.94	2.00	2.39	1.46	1.28	.50	.35	.58	2.00	3.00
16	3.90	4.65	2.18	1.94	2.65	1.48	1.15	.50	.33	.53	1.82	2.70
17	4.90	4.85	2.34	1.88	2.50	1.39	1.07	.47	.38	.50	2.16	2.40
18	5.50	4.80	2.18	1.80	2.40	1.30	1.18	.47	.34	.45	4.80	2.20
19	6.50	3.85	2.07	1.72	2.30	1.20	1.02	.43	.30	.80	6.61	2.00
20	6.20	3.27	1.98	1.76	2.20	1.20	.95	.42	1.45	1.16	5.80	1.88
21	6.00	2.83	1.90	1.63	2.05	1.15	.90	.42	1.78	1.55	4.15	1.70
22	4.40	2.48	1.77	1.66	1.94	1.10	.84	.42	.80	1.30	8.20	1.60
23	3.50	2.36	1.72	1.72	1.84	1.05	.80	.44	.64	1.10	7.20	1.50
24	3.00	3.02	1.69	1.65	1.88	1.00	.78	.42	.48	1.05	6.20	1.45
25	2.60	3.08	1.81	2.00	1.90	.95	.82	.40	.48	.95	4.65	1.40
26	2.40	2.83	1.89	2.60	2.31	1.3	.82	.64	.46	.85	3.80	1.30
27	2.18	3.00	2.00	4.95	2.85	1.06	.89	.53	.42	.80	3.18	1.28
28	1.96	3.10	2.20	3.90	2.63	.95	.95	.46	.40	.80	5.05	1.20
29	1.84	.....	2.50	3.00	3.40	.90	.82	.42	1.03	1.90	4.90	1.18
30	1.70	.....	2.50	2.65	3.93	.85	.76	.42	.86	1.45	5.15	1.20
31	1.63	.....	2.90	.....	3.70	.....	.72	.40	.....	3.25	.....	1.75

Daily gage height, in feet, of Bull Run River near Bullrun, Oreg., for 1909.

Day.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.10	2.78	.....	5.66	.....	16	2.91	.....	3.01	4.00	.....
2	3.08	2.78	3.05	.....	.....	17	2.89	.....	2.98	4.54	.....
3	3.06	2.77	2.99	8.70	.....	18	2.87	2.74	2.96	6.66	4.18
4	3.04	2.76	2.96	6.80	4.55	19	2.86	2.74	3.26	8.87	4.05
5	3.03	2.75	2.95	5.85	.....	20	2.85	3.31	3.51	7.75	3.95
6	3.01	2.75	3.85	5.44	.....	21	2.84	3.54	3.70	6.08	3.80
7	2.98	2.74	3.72	5.10	4.05	22	2.83	3.10	3.60	.....	3.70
8	2.97	2.74	3.47	5.40	4.00	23	2.83	2.97	3.44	.....	3.60
9	2.96	2.73	3.36	5.40	4.25	24	2.83	2.91	3.40	8.18	3.60
10	2.94	.....	.....	5.60	4.00	25	2.82	2.90	3.38	6.45	3 56
11	2.93	.....	3.20	5.20	4.60	26	2.92	.....	3.30	5.58	3.50
12	2.92	2.80	3.15	4.90	6.78	27	2.87	.....	3.25	5.08	3.45
13	2.91	2.78	3.12	4.62	6.15	28	2.82	.....	.....	6.65	3.40
14	2.91	2.76	3.09	4.35	5.35	29	2.81	3.40	.....	7.30	3.38
15	3.02	.....	3.06	4.15	.....	30	2.80	.....	3.80	.....	.....
						31	2.79	.....	5.23	.....	.....

NOTE.—These records from Friez self-registering gage.

Daily discharge, in second-feet, of Bull Run River near Bullrun, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	710	413	1,230	1,510	795	1,510	186	168	92	166	1,950	2,110
2	843	444	1,300	1,120	865	1,190	186	163	92	155	8,360	1,460
3	1,280	532	1,160	925	1,200	985	178	158	90	140	6,130	1,080
4	1,690	500	1,060	760	1,320	810	176	152	88	132	3,400	875
5	1,130	492	865	760	919	725	186	150	86	130	2,180	760
6	877	484	735	760	730	629	865	145	86	434	1,700	600
7	750	452	629	710	656	580	560	137	84	382	1,340	555
8	612	420	1,050	688	600	540	386	135	84	283	1,660	530
9	540	413	925	688	710	524	321	132	82	245	1,660	670
10	500	406	810	696	710	504	370	128	130	202	1,880	530
11	420	386	665	620	1,300	504	642	125	122	196	1,440	910
12	337	386	620	596	1,050	460	500	123	96	182	1,150	3,370
13	370	440	592	588	895	406	413	120	92	174	916	2,540
14	353	480	572	580	785	386	353	120	88	165	715	1,600
15	1,120	955	556	580	710	373	315	147	86	158	590	1,120
16	1,890	2,820	656	556	895	379	276	120	82	145	510	925
17	3,170	3,100	730	532	810	350	253	116	88	137	852	760
18	4,100	3,030	656	500	760	321	284	111	84	132	3,210	628
19	5,860	1,840	608	468	710	290	239	109	84	214	6,380	555
20	5,320	1,320	572	484	665	290	222	107	229	298	4,730	505
21	4,960	1,000	540	432	600	276	209	105	310	374	2,460	440
22	2,480	800	488	444	556	261	195	103	168	334	9,490	400
23	1,510	740	468	468	516	248	186	103	135	272	7,260	360
24	1,120	1,130	456	440	532	234	182	103	120	258	5,350	360
25	865	1,180	504	580	540	222	191	100	118	252	2,940	344
26	760	1,000	536	865	715	321	191	123	96	226	1,860	320
27	656	1,120	580	3,240	1,020	250	207	111	93	211	1,320	302
28	564	1,190	665	1,890	883	222	198	100	89	205	3,200	284
29	516	.....	810	1,120	1,420	209	191	98	258	540	4,100	277
30	460	.....	810	895	1,920	198	178	96	194	414	3,540	300
31	432	.....	1,050	.....	1,690	.....	169	94	.....	1,470	.....	480

NOTE.—The discharges are based on rating curves applicable as follows: Jan. 1 to July 31, fairly well defined and applied to staff gage records; Aug. 1 to Dec. 31, well defined between 80 and 230 second-feet; fairly well defined above 230 second-feet. Applied to Friez automatic gage records. For days on which automatic gage record is missing discharge has been obtained from an estimated gage height, which is determined from relation of staff gage.

Monthly discharge of Bull Run River near Bullrun, Oreg., for 1909.

[Drainage area, 96 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth, in inches, on drainage area.	Total in acre-feet.	
January	5,860	337	1,490	15.5	17.87	91,600	B.
February	3,100	386	981	10.2	10.62	54,500	B.
March	1,300	456	739	7.70	8.88	45,400	A.
April	3,240	432	816	8.50	9.48	48,600	A.
May	1,920	516	886	9.23	10.64	54,500	A.
June	1,510	198	473	4.93	5.50	28,100	A.
July	865	169	291	3.03	3.49	17,900	A.
August	168	94	123	1.28	1.48	7,560	A.
September	310	82	118	1.23	1.37	7,020	A.
October	1,470	130	278	2.90	3.34	17,100	A.
November	9,490	510	3,080	32.1	35.81	183,000	C.
December	3,370	277	837	8.72	10.05	51,500	B.
The year	9,490	82	843	8.78	118.53	607,000	

WILLAMETTE RIVER DRAINAGE BASIN.

DESCRIPTION.

Willamette River drains a trough-shaped area, extending north and south between the Coast and Cascade ranges in Oregon. The area is roughly rectangular, approximately 230 miles in length and about 85 miles in width. The Willamette proper is formed by the junction of three main tributaries which unite in the vicinity of Eugene; these are the Coast Fork, the Middle Fork, and the McKenzie. The river is navigable for ocean-going vessels from the mouth to Portland, and for ordinary river steamboats from Portland to Corvallis, except during a few months of each year. From Corvallis to Eugene the river is navigable for light-draft boats during medium stages of the river. The falls of Willamette River at Oregon City are passed by a series of five locks, which are at present in private ownership.

The other principal tributaries of Willamette River are Santiam, Molalla, and Clackamas rivers. From the Coast Range flow Long Tom, Marys, Luckiamute, Yamhill, and Tualatin rivers. The drainage areas of this river and its principal tributaries are given in the following table:

Drainage areas in Willamette River basin.

	Square miles.
Willamette at the mouth	11,150
Willamette at Oregon City	10,200
Willamette at Salem	7,520
Willamette at Albany	4,860
Coast Fork of the Willamette	705
Middle Fork of the Willamette	1,450
McKenzie River	1,040
Santiam River	1,890
Yamhill River	763
Clackamas River	927
Tualatin River	690

From the summit of the mountain ranges the slopes are steep, but they merge gradually into a wide alluvial valley or gently rolling agricultural lands.

The entire drainage area of this river was originally primeval forest, and although considerable areas in the valley have been cleared for agriculture the area may still be considered densely forested. The portions of the basin that contribute most to the flow of the streams are almost entirely within the boundaries of the national forests, while the privately owned timber lands extend from the boundaries of the national forests to the main stream in the valley, except where lands have been cleared. Thus whatever beneficial influence the original forest may have exerted on the regulation of stream flow, its effect is still in evidence, as the water-producing portions of the area have not been disturbed.

The mean annual rainfall presents some rather peculiar features. Although precipitation records at the summit of the Coast Range are meager, it is likely that the total annual rainfall is as much as 150 inches. As the eastern slope of the Coast Range is descended, precipitation falls very rapidly to about 40 inches, but gradually increases again until at the summit of the Cascade Range it is approximately 100 inches annually. From north to south the same general variation is observed; although the differences are not so striking. At the mouth of the river the precipitation is approximately 50 inches, which gradually decreases to about 40 in the vicinity of Corvallis, but increases again to 55 or 60 inches at the summit of the Calapooya Mountains, which form the southern boundary of the drainage area. Except on the summit of the mountain ranges this precipitation appears almost entirely as rainfall, 95 per cent falling during nine months, from September to May. On the mountain ranges part of the precipitation is snowfall, and the country is subject during the spring and fall to warm chinook winds, accompanied by rather sudden melting of these snows, which frequently cause considerable damage from floods. During the growing season when the precipitation rarely exceeds 2 inches, the country is practically an arid section. Although irrigation has not been practiced in the valley, it is likely that before many years a large part of the agricultural bottom lands will be placed under irrigation. Small ditches and pumping plants have been constructed, and the returns from irrigated agricultural lands show an increase of from 50 to 500 per cent in production over the nonirrigated lands.

This area has never been mapped topographically, so that it is impossible to determine the extent of storage facilities. The operation of storage reservoirs would, however, greatly increase the economic value of the river system, as it would probably render the river navigable from Eugene to its mouth during all portions of the year and at the same time diminish the damage from floods that annually threaten the agricultural lands and the industries of the valley. It would also make the river many times more valuable than it is at present for water-power development.

The highest known flood in the Willamette Valley occurred December, 1861, when the discharge at Albany was 220,000 cubic feet per second. The highest gage reading at Portland since that date occurred in 1894, but was due to backwater from Columbia River. The years 1899 and 1907 were "wet years." The year 1905 was a comparatively dry year. The longest record of stream flow in this basin has been obtained by applying recent measurements made at Albany to records obtained by the United States Weather Bureau since 1895.

MIDDLE FORK OF WILLAMETTE RIVER AT JASPER, OREG.

This station was established September 16, 1905, at the ferry near Jasper post office, Oregon, 2 miles above Natron and 3 miles below the mouth of Fall Creek.

The waters of this stream are particularly valuable for water power and will probably be used in the future for irrigation. The records also furnish some very reliable data concerning the run-off from heavily forested areas where the precipitation is high. A recently constructed storage reservoir at Waldo Lake on the North Fork of Middle Fork seems to augment the summer flow over what formerly obtained. Stored water was released during August and September, 1909.

The vertical staff gage is on the right bank about 30 feet above the cable. Discharge measurements are made from a cable equipment. The stream is largely used for transporting logs during all seasons of the year, and records of flow are therefore somewhat unreliable during the low-water periods, as logs frequently ground on the bars below the station and cause backwater on the gage. Except for this, the records are reliable, and no change of gage datum has occurred since the station was established.

Discharge measurements of Middle Fork of Willamette River at Jasper, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 16	H. D. McGlashan	448	3,630	9.30	35,700
16	do	446	3,400	8.80	31,900
Jan. 17	do	438	2,890	7.55	21,000

Daily gage height, in feet, of Middle Fork of Willamette River at Jasper, Oreg., for 1909.

[Philip Sylvester, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4.0	3.8	5.4	3.7	3.3	4.7	2.6	2.5	2.3	2.5	4.4	6.8
2	3.8	3.7	5.5	3.9	3.3	4.8	2.6	2.5	2.3	2.5	3.2	6.2
3	4.0	4.1	5.4	3.8	3.5	4.6	2.6	2.4	2.3	2.4	3.1	5.7
4	5.8	4.1	5.3	3.8	4.0	4.3	2.6	2.4	2.3	2.3	2.8	5.4
5	6.6	4.1	5.0	3.7	3.9	4.1	2.6	2.4	2.3	2.3	2.8	5.3
6	7.1	4.0	4.8	3.8	3.7	3.9	3.1	2.4	2.3	2.3	2.9	5.0
7	7.8	3.8	4.5	3.6	3.5	3.7	3.5	2.4	2.3	2.4	2.8	5.0
8	7.8	3.7	4.8	3.5	3.3	3.5	3.0	2.4	2.3	2.3	2.7	5.1
9	6.2	3.6	4.6	3.4	3 3	3.4	2.8	2.4	2.3	2.3	2.8	5.8
10	5.3	3.7	4.5	3.4	3.4	3.3	2.8	2.4	2.3	2.4	3.1	6.0
11	4.8	3.7	4.2	3.8	3.5	3.3	2.7	2.4	2.4	2.4	3.9	5.6
12	4.5	3.7	4.0	3.2	3.4	3.4	2.7	2.4	2.4	2.6	3.1	6.8
13	4.3	4.4	3.9	3.1	3.3	3.3	2.6	2.4	2.3	2.7	3.0	7.9
14	4.1	4.7	3.8	3.3	3.2	3.2	2.6	2.3	2.3	2.7	3.0	7.0
15	6.6	4.7	3.8	3.3	3.1	3.2	2.6	2.3	2.3	2.7	2.8	6.2
16	9.8	4.9	3.7	3.5	3.1	3.2	2.6	2.3	2.3	2.7	2.7	5.7
17	7.5	7.1	4.0	3.7	3.1	3.3	2.6	2.3	2.3	2.3	2.6	5.4
18	8.9	6.4	4.3	3.8	3.0	3.2	2.6	2.2	2.3	2.3	2.9	5.2
19	7.7	6.2	4.3	3.8	3.0	3.2	2.6	2.2	2.3	2.3	4.9	5.0
20	8.2	5.9	3.8	4.5	3.0	3.2	2.5	2.2	2.3	2.4	8.8	4.9

Daily gage height, in feet, of Middle Fork of Willamette River at Jasper, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	9.7	5.8	3.7	3.2	3.0	3.2	2.5	2.2	2.3	2.5	6.7	4.7
22	8.5	5.3	3.6	3.1	3.0	3.2	2.5	2.2	2.3	2.5	10.2	4.7
23	7.0	4.9	3.3	3.1	2.9	3.4	2.5	2.3	2.3	2.5	16.6	4.6
24	6.1	5.5	3.3	3.0	2.9	3.2	2.5	2.3	2.3	2.4	11.6	4.4
25	5.6	6.0	3.2	3.0	2.9	2.9	2.5	2.3	2.3	2.4	8.5	4.4
26	5.1	5.6	3.2	3.1	3.0	2.8	2.5	2.3	2.3	2.3	7.2	4.3
27	4.7	5.2	3.2	3.3	3.5	2.8	2.6	2.3	2.3	2.3	6.5	4.2
28	4.5	5.5	3.4	3.7	4.2	2.7	2.6	2.3	2.3	2.3	6.4	4.1
29	4.3	.....	3.5	3.6	4.2	2.7	2.5	2.3	2.4	2.4	6.2	4.1
30	4.1	.....	3.5	3.4	4.3	2.7	2.5	2.3	2.5	2.4	7.2	4.1
31	4.0	.....	3.5	.....	4.7	.....	2.5	2.3	.....	3.2	.....	5.4

Daily discharge, in second-feet, of Middle Fork of Willamette River at Jasper, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,240	3,750	9,200	3,520	2,670	6,340	1,510	1,380	1,150	1,380	5,370	11,400
2	3,750	3,520	9,650	3,990	2,670	6,700	1,510	1,380	1,150	1,380	2,480	8,640
3	4,240	4,500	9,200	3,750	3,080	6,000	1,510	1,260	1,150	1,260	2,290	6,610
4	11,100	4,500	8,760	3,750	4,240	5,070	1,510	1,260	1,150	1,150	1,790	5,570
5	15,300	4,500	7,480	3,520	3,990	4,500	1,510	1,260	1,150	1,150	1,790	5,250
6	18,200	4,240	6,700	3,750	3,520	3,990	2,290	1,260	1,150	1,150	1,940	4,400
7	23,100	3,750	5,680	3,300	3,080	3,520	3,080	1,260	1,150	1,260	1,790	4,400
8	23,100	3,520	5,680	3,080	2,670	3,080	2,110	1,260	1,150	1,150	1,650	4,670
9	13,100	3,300	6,000	2,870	2,670	2,870	1,790	1,260	1,150	1,150	1,790	6,990
10	8,760	3,520	5,680	2,870	2,870	2,670	1,790	1,260	1,150	1,150	2,290	7,800
11	6,700	3,520	4,780	3,750	3,080	2,670	1,650	1,260	1,260	1,150	3,990	6,250
12	5,680	3,520	4,240	2,480	2,870	2,870	1,650	1,260	1,260	1,150	2,290	11,400
13	5,070	5,370	3,990	2,290	2,670	2,670	1,510	1,260	1,150	1,150	2,110	17,000
14	4,500	6,340	3,750	2,670	2,480	2,480	1,510	1,150	1,150	1,150	2,110	12,400
15	15,300	6,340	3,750	2,670	2,290	2,480	1,510	1,150	1,150	1,150	1,790	8,640
16	40,400	7,080	3,520	2,480	2,290	2,480	1,510	1,150	1,150	1,150	1,650	6,610
17	20,900	18,200	4,240	2,480	2,290	2,670	1,510	1,150	1,150	1,150	1,510	5,570
18	32,100	14,200	5,070	2,480	2,110	2,480	1,510	1,050	1,150	1,150	1,940	4,950
19	22,300	13,100	5,070	2,480	2,110	2,480	1,510	1,050	1,150	1,150	7,080	4,400
20	26,200	11,600	3,750	2,480	2,110	2,480	1,380	1,050	1,150	1,260	31,200	4,140
21	39,500	11,100	3,520	2,480	2,110	2,480	1,380	1,050	1,150	1,380	15,800	3,630
22	28,700	8,760	3,300	2,290	2,110	2,480	1,380	1,050	1,150	1,380	44,500	3,630
23	17,600	7,080	2,670	2,290	1,940	2,480	1,380	1,150	1,150	1,380	122,000	3,390
24	12,600	9,650	2,670	2,110	1,940	2,480	1,380	1,150	1,150	1,260	54,700	2,940
25	10,100	12,000	2,480	2,110	1,940	1,940	1,380	1,150	1,150	1,260	21,900	2,940
26	7,900	10,100	2,480	2,290	2,110	1,790	1,380	1,150	1,150	1,150	13,400	2,730
27	6,340	8,330	2,480	2,670	3,080	1,790	1,510	1,150	1,150	1,150	9,980	2,530
28	5,680	9,650	2,870	3,520	4,780	1,650	1,510	1,150	1,150	1,150	9,520	2,330
29	5,070	.....	3,080	3,300	4,780	1,650	1,380	1,150	1,260	1,260	8,640	2,330
30	4,500	.....	3,080	2,870	5,070	1,650	1,380	1,150	1,380	1,260	13,400	2,330
31	4,240	.....	3,080	.....	6,340	.....	1,380	1,150	.....	2,480	.....	5,570

NOTE.—The above discharges are based on rating curves applicable as follows:

Jan. 1 to Nov. 23, well defined between 880 and 42,400 second-feet (same as published in Water-Supply Paper 252, p. 351).

Nov. 24 to Dec. 31, well defined between 670 and 1,340 second-feet and fairly well defined above 1,340 second-feet.

Apr. 16 to 20, discharges estimated: June 23, Oct. 10 to 16, discharges interpolated on account of log driving.

Stored water was released from Waldo Lake during July, August, and September.

Monthly discharge of Middle Fork of Willamette River at Jasper, Oreg., for 1909.

[Drainage area, 1,450 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	40,400	3,750	14,400	9.93	11.45	885,000	A.
February	18,200	3,300	7,320	5.05	5.26	407,000	A.
March	9,650	2,480	4,770	3.29	3.79	293,000	A.
April	3,990	2,110	2,890	1.99	2.22	172,000	B.
May	6,340	1,940	2,970	2.05	2.36	183,000	B.
June	6,700	1,650	3,030	2.09	2.33	180,000	B.
July	3,080	1,380	1,590	1.10	1.27	97,800	B.
August	1,380	1,050	1,190	.821	.95	73,200	B.
September	1,380	1,150	1,170	.807	.90	69,600	B.
October	2,480	1,150	1,250	.862	.99	76,900	B.
November	122,000	1,510	13,100	9.03	10.08	780,000	B.
December	17,600	2,330	5,870	4.05	4.67	361,000	A.
The year	122,000	1,050	4,960	3.42	46.27	3,580,000	

NOTE.—Stored water was released from Waldo Lake during July, August, and September.

WILLAMETTE RIVER AT ALBANY, OREG.

On July 21, 1905, the United States Geological Survey established a station at the Corvallis & Eastern Railroad bridge within the city limits of Albany, Oreg. It is below the mouth of Calapooya River and 7 miles above the mouth of Santiam River. The staff gage is located on the second pier from the right bank and discharge measurements are made from the railroad bridge.

The United States Weather Bureau has maintained records of gage heights at Albany, Oreg., since 1879. On September 27, 1906, the Weather Bureau gage was moved from its former location on the steel highway bridge, 2,000 feet above the railroad bridge, to a better and more convenient location. The present gage is in two sections. The first is attached to one of the piers of the dock of Westgate Bros. The high-water section is attached to their warehouse and 30 feet nearer the shore.

Continuous records of gage heights have been obtained from the United States Geological Survey gage since the station was established, but as conditions are more favorable for better results at the upper sections estimates have been computed based on the Weather Bureau gage heights.[1] In constructing the rating curve for this gage the earlier measurements at medium and low stages have been platted as coordinates with the Weather Bureau observer's reading for the day.

The data at this station are especially valuable in the determination of run-off values from forested areas and will be of economic impor-

[1] Monthly and yearly estimates of discharge for 1879, 1892 to 1908 were published in Water-Supply Paper U. S. Geol. Survey No. 252, 1910, pp. 354-358.

tance in the proper design of river improvements for navigation purposes and in the development of water power and irrigation.

No discharge measurements were made during 1909.

The gage heights for 1909 were furnished by the United States Weather Bureau.

Daily gage height, in feet, of Willamette River at Albany, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	6.0	6.0	10.6	4.2	3.4	5.3	1.9	1.2	0.9	1.3	1.8	12.0
2	5.3	5.7	10.4	4.6	3.3	5.3	1.8	1.2	.9	1.4	4.6	11.7
3	5.0	6.3	10.7	5.0	3.3	5.3	1.8	1.1	.9	1.3	4.0	10.0
4	5.4	7.1	10.4	4.8	3.6	4.9	1.8	1.1	.8	1.2	4.4	8.5
5	8.8	7.2	10.0	4.6	4.1	4.6	1.8	1.1	.8	1.1	3.4	7.5
6	10.5	7.2	9.7	4.5	4.0	4.3	1.8	1.1	.8	1.0	3.0	7.0
7	12.7	7.2	8.4	4.4	3.8	3.9	2.4	1.1	.8	1.0	3.0	6.5
8	14.2	7.0	7.6	4.2	3.5	3.8	3.2	1.1	.8	1.5	3.1	7.0
9	15.3	6.6	7.2	4.0	3.3	3.4	2.8	1.1	.8	1.1	3.3	9.0
10	13.5	6.6	7.3	3.9	3.3	3.2	2.3	1.1	.8	1.0	3.6	12.3
11	10.5	6.7	6.8	3.9	3.4	3.2	2.0	1.0	.8	1.0	4.7	11.5
12	8.4	6.7	6.5	3.8	3.6	3.1	2.0	1.0	.8	1.0	5.8	11.0
13	7.0	7.0	5.9	3.7	3.5	3.1	2.0	1.0	.8	1.0	4.9	12.7
14	6.4	7.8	5.6	3.6	3.3	3.0	2.0	1.0	.8	1.0	4.4	14.5
15	6.0	8.1	5.4	3.5	3.2	2.9	1.9	1.0	.8	1.0	4.2	12.8
16	12.4	8.3	5.2	3.5	3.1	2.8	1.8	1.0	.8	.9	3.6	10.8
17	18.2	9.3	5.1	3.4	3.0	2.8	1.7	1.0	.8	.9	3.2	8.8
18	20.5	13.3	5.3	3.4	3.0	2.8	1.7	1.0	.8	.8	3.0	7.7
19	19.8	13.3	5.2	3.4	2.9	2.7	1.6	1.0	.8	.9	3.3	6.8
20	20.3	13.1	5.0	3.3	2.8	2.7	1.6	1.0	.8	1.1	7.7	6.3
21	21.0	12.6	4.9	3.2	2.8	2.6	1.6	1.0	.8	1.4	13.3	5.8
22	23.4	12.1	4.7	3.2	2.8	2.4	1.6	1.0	.8	1.7	14.3	5.3
23	23.3	10.5	4.5	3.0	2.8	2.4	1.5	1.0	.8	1.7	16.3	4.9
24	18.5	9.2	4.2	3.0	2.7	2.3	1.5	1.0	.8	1.7	28.5	4.6
25	13.5	10.3	4.1	3.0	2.6	2.2	1.5	1.0	.8	1.5	29.3	4.4
26	10.9	12.0	4.0	3.0	2.6	2.2	1.4	1.0	.8	1.2	24.4	4.2
27	9.3	11.2	3.9	2.9	2.7	2.1	1.3	1.0	.8	1.0	18.8	4.1
28	8.2	10.5	3.9	3.2	3.3	2.1	1.3	1.0	.8	1.0	12.4	4.0
29	7.3	.....	4.0	3.8	4.1	2.0	1.3	.9	.8	1.0	11.0	3.8
30	6.6	.....	4.1	3.7	4.5	2.0	1.2	.9	1.0	1.1	10.7	3.7
31	6.2	.....	4.2	.....	4.6	.....	1.2	.9	.....	1.2	.....	4.2

Daily discharge, in second-feet, of Willamette River at Albany, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	16,800	16,800	35,800	11,200	8,950	14,500	5,270	3,730	3,140	3,940	5,040	42,500
2	14,500	15,800	34,800	12,400	8,690	14,500	5,040	3,730	3,140	4,150	12,400	41,000
3	13,600	17,800	36,200	13,600	8,690	14,500	5,040	3,530	3,140	3,940	10,600	33,000
4	14,800	20,700	34,800	13,000	9,490	13,300	5,040	3,530	2,950	3,730	11,800	26,300
5	27,600	21,000	33,000	12,400	10,900	12,400	5,040	3,530	2,950	3,530	8,950	22,200
6	35,300	21,000	31,600	12,100	10,600	11,500	5,040	3,530	2,950	3,330	7,920	20,300
7	46,000	21,000	25,900	11,800	10,000	10,300	6,450	3,530	2,950	3,330	7,920	18,500
8	54,100	20,300	22,600	11,200	9,220	10,000	8,430	3,530	2,950	4,360	8,170	20,300
9	60,300	18,900	21,000	10,600	8,690	8,950	7,420	3,530	2,950	3,530	8,690	28,500
10	50,300	18,900	21,400	10,300	8,690	8,430	6,210	3,530	2,950	3,330	9,490	44,000
11	35,300	19,200	19,600	10,300	8,950	8,430	5,500	3,330	2,950	3,330	12,700	40,000
12	25,900	19,200	18,500	10,000	9,490	8,170	5,500	3,330	2,950	3,330	16,100	37,600
13	20,300	20,300	16,500	9,760	9,220	8,170	5,500	3,330	2,950	3,330	13,300	46,000
14	18,200	23,400	15,500	9,490	8,690	7,920	5,500	3,330	2,950	3,330	11,800	55,800
15	16,800	24,600	14,800	9,220	8,430	7,670	5,270	3,330	2,950	3,330	11,200	46,600
16	44,500	25,500	14,200	9,220	8,170	7,420	5,040	3,330	2,950	3,140	9,490	36,700
17	78,400	29,800	13,900	8,950	7,920	7,420	4,810	3,330	2,950	3,140	8,430	27,600
18	94,000	49,200	14,500	8,950	7,920	7,420	4,810	3,330	2,950	2,950	7,920	23,000
19	89,100	49,200	14,200	8,950	7,670	7,170	4,580	3,330	2,950	3,140	8,690	19,600
20	92,600	48,100	13,600	8,690	7,420	7,170	4,580	3,330	2,950	3,530	23,000	17,800

Daily discharge, in second-feet, of Willamette River at Albany, Oreg., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	97,400	45,500	13,300	8,430	7,420	6,930	4,580	3,330	2,950	4,150	49,200	16,100
22	115,000	43,000	12,700	8,430	7,420	6,450	4,580	3,330	2,950	4,810	54,600	14,500
23	115,000	35,300	12,100	7,920	7,420	6,450	4,360	3,330	2,950	4,810	66,300	13,300
24	80,400	29,400	11,200	7,920	7,170	6,210	4,360	3,330	2,950	4,810	160,000	12,400
25	50,300	34,400	10,900	7,920	6,930	5,970	4,360	3,330	2,950	4,360	168,000	11,800
26	37,200	42,500	10,600	7,920	6,930	5,970	4,150	3,330	2,950	3,730	123,000	11,200
27	29,800	38,600	10,300	7,670	7,170	5,730	3,940	3,330	2,950	3,330	82,400	10,900
28	25,000	35,300	10,300	8,430	8,690	5,730	3,940	3,330	2,950	3,330	44,500	10,600
29	21,400	.....	10,600	10,000	10,900	5,500	3,940	3,140	2,950	3,530	37,600	10,000
30	18,900	.....	10,900	9,760	12,100	5,500	3,730	3,140	3,330	3,730	36,200	9,760
31	17,500	.....	11,200	.....	12,400	.....	3,730	3,140	.....	4,380	.....	11,200

NOTE.—These discharges are based on a rating curve that is well defined between 2,700 and 13,600 second-feet and fairly well defined above 13,600 second-feet. For rating table see Water-Supply Paper 252, p. 354.

Monthly discharge of Willamette River at Albany, Oreg., for 1909.

[Drainage area, 4,860 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	115,000	13,600	47,000	9.67	11.15	2,890,000	B.
February	49,200	15,800	28,700	5.91	6.15	1,590,000	A.
March	36,200	10,300	18,600	3.83	4.42	1,140,000	A.
April	13,600	7,670	9,880	2.03	2.26	588,000	A.
May	12,400	6,930	8,790	1.81	2.09	540,000	A.
June	14,500	5,500	8,530	1.76	1.96	508,000	A.
July	8,430	3,730	5,020	1.03	1.19	309,000	A.
August	3,730	3,140	3,390	.70	.81	208,000	A.
September	3,330	2,950	2,980	.613	.68	177,000	A.
October	4,810	2,950	3,700	.761	.88	228,000	A.
November	168,000	5,040	34,500	7.10	7.92	2,050,000	B.
December	55,800	9,760	25,100	5.16	5.95	1,540,000	A.
The year	168,000	2,950	16,350	3.36	45.46	11,770,000	

WILLAMETTE RIVER AT OREGON CITY, OREG.

This station is located about a mile below the falls at Oregon City, Oreg., and above Clackamas Rapids.

Gage heights are obtained from a vertical staff gage located at the foot of the falls in the lower locks, and have been recorded since August 19, 1883. The gage heights are affected by back water from Columbia River at high stages, and probably by back water from Clackamas River at high stages of that stream, but during the summer months the gage heights would be fairly good index of the discharge. The station was established by the Portland Railway, Light & Power Co. with the intention of developing a discharge curve to which the old gage heights during the summer months could be applied.

At ordinary stages the waters of Willamette River at this point are entirely used for power development. The Portland Railway,

Light & Power Co. has the major interest in the water rights at this point. Besides furnishing power for municipal uses at Portland, the company leases power to the several paper mills at Oregon City. The aggregate installation of power wheels probably amounts to 40,000 horsepower, but there is only sufficient water to develop 10,000 horsepower at low stages of the river. During such periods the paper mills are obliged to use steam power or suspend work. The Portland Railway, Light & Power Co. also owns and operates the locks at this point. The fall of the river at low water is about 41 feet, and a dam has been constructed around the brink of the falls where, by means of flashboards, the head is increased for low stages of the river. This causes backwater for many miles up stream, and it was impossible to select a site where a discharge curve could be developed for all stages of the river. The point selected was the only one in that vicinity where the determination of discharge could be made, and here the flow will be more or less under artificial control.

Discharge measurements are made from a boat held by a cable which is stretched across the river at the time of gaging. Up to the present time a sufficient number of measurements have not been made to develop a rating curve here.

Discharge measurements of Willamette River at Oregon City, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Sept. 3	Stevens and Post	235	2,280	2.90	4,550
12	R. B. Post	210	2,090	1.97	3,310
Oct. 12	Henshaw and Allen	245	2,390	3.20	5,620

Daily gage height, in feet, of Willamette River at Oregon City, Oreg., for 1909.

[F. C. Miller, jr., observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	12.4	12.1	16.2	9.4	8.1	12.3	14.8	6.0	2.9	2.7	5.65	20.7
2	11.5	12.6	16.1	10.6	7.9	12.5	14.5	6.1	2.7	3.0	9.3	20.35
3	11.8	12.8	16.3	10.4	7.8	12.7	14.2	5.9	2.7	3.4	13.35	19.2
4	12.5	13.7	16.4	10.1	8.2	12.9	13.9	5.6	2.7	3.6	13.4	16.85
5	13.4	13.7	15.9	11.0	8.3	13.6	13.6	5.0	2.5	2.9	11.85	15.1
6	14.4	13.7	15.3	9.6	8.6	14.6	13.3	4.9	2.7	2.9	10.5	13.95
7	15.0	13.8	14.3	9.4	8.5	15.5	13.3	4.9	2.7	2.6	9.4	12.9
8	16.2	13.7	13.6	9.1	7.9	16.1	13.3	4.5	2.7	2.6	9.5	12.65
9	17.0	13.1	13.1	8.8	7.5	16.5	13.1	4.7	2.6	2.8	10.45	13.25
10	17.2	12.8	12.8	8.15	7.5	16.6	12.7	4.5	2.7	2.5	11.45	15.55
11	15.8	12.9	12.7	8.1	7.5	16.4	12.4	4.3	2.5	3.0	12.15	17.25
12	13.6	12.9	11.9	8.5	7.9	16.1	12.2	4.2	1.9	2.8	12.45	18.35
13	12.2	12.9	11.4	8.2	8.1	15.9	12.2	3.9	2.5	2.8	11.9	20.05
14	11.2	13.3	10.7	8.0	7.9	15.8	12.1	3.8	2.7	2.8	10.85	21.4
15	10.7	13.7	10.5	7.9	7.9	15.8	11.9	3.7	2.7	2.7	10.2	20.95
16	14.6	14.3	10.2	7.8	7.1	15.8	11.5	3.9	2.7	2.7	9.3	19.65
17	19.3	17.0	10.1	7.7	7.6	16.2	11.2	3.4	2.6	2.5	8.6	17.0
18	23.0	18.9	10.3	7.5	7.4	16.4	10.6	3.1	2.6	2.4	9.0	15.0
19	24.9	20.3	10.3	7.6	7.5	16.7	10.3	3.0	2.4	2.6	12.2	13.9
20	27.4	20.7	10.0	7.6	7.5	17.0	9.8	3.0	2.5	2.8	17.6	12.75

Daily gage height, in feet, of Willamette River at Oregon City, Oreg., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
21	30.4	19.8	9.8	7.4	7.3	17.3	9.2	2.8	2.4	2.8	19.45	12.0
22	31.6	18.6	9.7	7.3	7.0	17.3	8.6	2.0	2.4	3.6	22.8	11.3
23	30.7	17.0	9.3	7.1	6.8	17.2	8.2	2.9	2.5	5.2	25.5	10.6
24	29.0	15.8	9.0	7.0	6.7	16.8	7.6	2.9	2.6	4.7	29.6	10.0
25	26.0	15.5	8.7	6.8	6.6	16.7	7.1	2.7	2.5	4.7	32.75	9.45
26	21.0	16.2	8.6	6.9	6.7	16.3	7.0	2.9	2.4	3.7	35.85	9.3
27	17.0	16.5	8.5	7.3	6.8	15.9	6.7	2.9	2.5	3.2	32.9	9.0
28	15.1	16.2	8.2	8.3	7.5	15.7	6.5	2.7	2.7	3.4	27.15	8.8
29	13.8	.....	8.7	8.9	8.6	15.5	6.4	2.5	3.0	3.3	22.5	8.4
30	12.8	.....	8.6	8.3	9.5	15.1	6.4	2.9	2.7	3.3	20.9	8.05
31	12.2	.....	9.0	.....	11.5	.....	6.2	2.1	.....	3.2	.....	8.65

NOTE.—One reading daily until after Oct. 31, when readings were taken morning and evening, at foot of locks.

KELSEY RIVER NEAR HAZELDELL, OREG.[1]

Kelsey River is the next important tributary of the Middle Fork of the Willamette above the North Fork.

This station was established October 12, 1909, in cooperation with the United States Geological Survey by the Waldo Lake Irrigation & Power Co. at a highway bridge on the Willamette military road, 1 mile above the mouth of the stream.

The chain gage is attached to the wagon bridge, from which discharge measurements are made at high water. Measurements at low water are made by wading.

The right bank is high and rocky; the left is comparatively low and will overflow at high water. The bed is of gravel and cobblestones and fairly permanent. The data obtained at this station are valuable chiefly in connection with power development.

The following discharge measurement was made by A. P. Stover:

October 11, 1909: Width, 65 feet; area, 86 square feet; gage height, 2.00 feet; discharge, 139 second-feet.

Daily gage height, in feet, of Kelsey River near Hazeldell, Oreg., for 1909.

[Virgil Hebert, observer.]

Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.	Day.	Oct.	Nov.
1	.....	2.7	9	.....	2.3	17	2.0	2.2	25	2.0	.....
2	.....	2.45	10	.....	2.35	18	2.0	2.2	26	2.0	.....
3	.....	2.35	11	2.0	2.35	19	2.1	3.6	27	2.0	.....
4	.....	2.3	12	2.0	2.35	20	2.1	6.0	28	2.0	.....
5	.....	2.25	13	2.0	2.4	21	2.15	3.7	29	2.1	.....
6	.....	2.3	14	2.0	2.3	22	2.05	.....	30	2.1	.....
7	.....	2.25	15	2.0	2.2	23	2.0	.....	31	2.6	.....
8	.....	2.2	16	2.0	2.2	24	2.0	.....			

NOTE.—Gage washed out on Nov. 22.

[1] Locally known as Salmon Creek.

NORTH FORK OF MIDDLE FORK OF WILLAMETTE RIVER NEAR HAZELDELL, OREG.

This station was established October 12, 1909, by the Waldo Lake Irrigation & Power Co., which cooperates with the Geological Survey in its maintenance. It is located half a mile above the confluence of the North Fork with the Middle Fork of Willamette River and half a mile below the Willamette military road crossing. A storage reservoir has been built at Waldo Lake, which makes possible the irrigation of considerable agricultural land in the lower valley. At present the waters are used principally for driving logs during the low-water season.

The gage is a vertical staff on the right bank, spiked to a maple tree. The discharge measurements are made by wading at low water, or from the highway bridge half a mile above at high water. Both banks of the stream are high, and the bed of the stream is composed of gravel and cobblestones, and is fairly permanent.

The data at present available are insufficient for a determination of discharge.

The following discharge measurement was made by A. P. Stover:

October 12, 1909: Width, 92 feet; area, 126 square feet; gage height, 1.03 feet; discharge, 165 second-feet.

Daily gage height, in feet, of North Fork of Middle Fork of Willamette River near Hazeldell, Oreg., for 1909.

[Gus Furnish, observer.]

Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.	Day.	Oct.	Nov.	Dec.
1			4.5	11		1.8	4.4	21	1.2	4.85	2.9
2			4.0	12	1.03	1.8	5.2	22	1.15	12.4	2.8
3			3.7	13	1.0	1.7	5.7	23	1.1	11.5	2.7
4		1.8	3.5	14	1.0	1.6	4.7	24	1.0	8.4	2.6
5		1.7	3.3	15	1.0	1.6	4.1	25	1.0	6.55	2.55
6		1.7	3.1	16	1.0	1.5	3.8	26	1.0	5.8	2.5
7		1.6	3.0	17	1.0	1.4	3.5	27		4.5	2.4
8		1.5	3.2	18	1.1	1.6	3.4	28		4.8	2.35
9		1.65	3.6	19	1.2	4.65	3.1	29		5.1	2.3
10		1.9	4.0	20	1.3	4.7	3.0	30		4.5	2.6
								31			2.9

COAST FORK OF WILLAMETTE RIVER NEAR GOSHEN, OREG.

This station was established August 23, 1905, and has been maintained continuously since that date. It is located at a highway bridge 3 miles east of Goshen, 9 miles southeast of Eugene, 5 miles west of Jasper, Oreg., and 4 miles above the mouth of Coast Fork.

The gage is in two sections. The lower section is nailed vertically to an old pier in the center of the stream, the upper portion is painted on the lower bridge caisson on the left bank. Discharge measurements are made from the highway bridge.

The records are of value in a general study of run-off conditions in the Willamette Valley. If storage could be supplied the stream would be valuable for both water-power and irrigation development. Gages have washed out at times, but they have been replaced at the same datum and no material inaccuracy in the records has been caused on this account.

The following discharge measurement was made by H. D. McGlashan:

Jan. 18, 1909: Width, 266 feet; area, 2,400 square feet; gage height, 10.02 feet; discharge, 14,800 second-feet.

Daily gage height, in feet, of Coast Fork of Willamette River near Goshen, Oreg., for 1909.

[J. D. West, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.9	3.0	5.4	2.5	1.25	2.5	0.75	0.65	0.35	0.85	2.5	6.8
2	2.7	3.0	5.4	3.0	1.25	1.65	.65	.65	.35	.85	3.9	5.2
3	3.5	3.5	5.5	2.8	1.35	1.55	.65	.65	.35	.85	2.8	4.6
4	6.3	3.7	5.7	2.5	1.45	1.45	.65	.65	.35	.85	2.5	4.0
5	6.4	3.9	4.6	2.5	1.35	1.35	.65	.6	.35	.75	1.05	3.8
6	7.0	3.5	4.4	1.65	1.35	1.35	1.15	.55	.35	.75	.75	3.9
7	9.3	3.45	4.0	1.65	1.35	1.25	1.55	.55	.35	.65	1.65	3.6
8	10.4	3.4	3.7	1.45	1.25	1.25	1.25	.55	.35	.65	2.5	4.5
9	6.5	3.3	3.9	1.35	1.15	1.15	1.15	.55	.35	.65	2.9	7.6
10	4.9	3.3	3.7	1.35	1.15	1.15	1.15	.55	.35	.65	4.2	6.0
11	3.9	3.3	3.4	1.25	1.35	1.15	1.15	.55	.35	.55	3.9	5.0
12	3.5	3.4	3.1	1.15	1.35	1.15	1.15	.4	.35	.55	3.0	5.8
13	3.0	4.7	3.0	1.05	1.35	1.15	1.10	.35	.35	.55	2.5	6.2
14	2.9	4.8	3.0	1.05	1.25	1.15	1.05	.35	.35	.55	2.7	5.6
15	7.8	4.5	2.8	1.05	1.25	1.05	.95	.35	.35	.55	2.4	4.6
16	13.7	4.5	2.7	1.05	1.25	1.05	.75	.35	.35	.55	2.3	4.0
17	8.0	4.4	2.8	.95	1.25	1.15	.65	.35	.35	.55	2.2	3.8
18	10.5	5.9	2.7	1.35	1.15	1.05	.65	.35	.35	.75	2.2	3.7
19	7.5	6.4	2.6	1.45	1.15	1.05	.65	.35	.35	.85	4.3	3.2
20	10.0	6.0	2.5	1.45	1.15	1.05	.6	.35	.35	1.25	7.2	3.0
21	11.0	6.4	1.75	1.35	1.15	.95	.55	.35	.35	1.35	6.4	2.9
22	9.5	5.3	1.65	1.35	1.15	.95	.55	.35	.35	1.25	7.8	2.6
23	6.5	4.3	1.45	1.25	1.15	.95	.55	.35	.35	1.05	11.4	2.5
24	5.3	4.4	1.35	1.25	1.05	.85	.55	.35	.35	.85	16.0	2.5
25	4.5	7.4	1.25	1.25	1.05	.85	.65	.35	.35	.75	8.8	2.5
26	3.7	5.0	1.25	1.25	1.15	.85	.7	.35	.35	.75	6.0	2.5
27	3.4	5.2	1.25	1.35	1.25	.85	.75	.35	.35	.75	5.1	2.5
28	3.3	5.5	1.25	1.45	1.45	.8	.75	.35	.35	.65	5.2	2.5
29	3.2	.....	1.35	1.35	1.75	.75	.7	.35	.55	.65	4.5	2.6
30	3.0	.....	1.35	1.35	2.6	.75	.65	.35	.75	.65	4.1	2.6
31	3.0	.....	1.65	.....	2.5	.....	.65	.35	.....	1.15	.....	2.7

Daily discharge, in second-feet, of Coast Fork of Willamette River near Goshen, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,870	1,980	5,480	1,450	465	1,450	196	151	54	245	1,450	8,030
2	1,650	1,980	5,480	1,980	465	728	151	151	54	245	3,150	5,140
3	2,590	2,590	5,650	1,760	526	655	151	151	54	245	1,760	4,150
4	7,090	2,870	6,010	1,450	588	588	151	151	54	245	1,450	3,290
5	7,270	3,150	4,150	1,450	526	526	151	130	54	196	348	3,010
6	8,410	2,590	3,850	728	526	526	405	112	54	196	196	3,150
7	13,200	2,520	3,290	728	526	465	655	112	54	151	728	2,730
8	15,700	2,450	2,870	588	465	465	465	112	54	151	1,450	4,000
9	7,460	2,320	3,150	526	405	405	405	112	54	151	1,870	9,600
10	4,630	2,320	2,870	526	405	405	405	112	54	151	3,570	6,550

Daily discharge, in second-feet, of Coast Fork of Willamette River near Goshen, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	3,150	2,320	2,450	465	526	405	405	112	54	112	3,150	4,800
12	2,590	2,450	2,090	405	526	405	405	65	54	112	1,980	6,190
13	1,980	4,310	1,980	348	526	405	375	54	54	112	1,450	6,910
14	1,870	4,470	1,980	348	465	405	348	54	54	112	1,650	5,830
15	10,000	4,000	1,760	348	465	348	295	54	54	112	1,350	4,150
16	24,400	4,000	1,650	348	465	348	196	54	54	112	1,250	3,290
17	10,400	3,850	1,760	295	465	405	151	54	54	112	1,160	3,010
18	16,000	6,370	1,650	526	405	348	151	54	54	196	1,160	2,870
19	9,400	7,270	1,550	588	405	348	151	54	54	245	3,710	2,200
20	14,800	6,550	1,450	588	405	348	130	54	54	465	8,800	1,980
21	17,200	7,270	802	526	405	295	112	54	54	526	7,270	1,870
22	13,600	5,310	728	526	405	295	112	54	54	465	10,000	1,550
23	7,460	3,710	588	465	405	295	112	54	54	348	18,200	1,450
24	5,310	3,850	526	465	348	245	112	54	54	245	31,300	1,450
25	4,000	9,200	465	465	348	245	151	54	54	196	12,100	1,450
26	2,870	4,800	465	465	405	245	172	54	54	196	6,550	1,450
27	2,450	5,140	465	526	465	245	196	54	54	196	4,970	1,450
28	2,320	5,650	465	588	588	220	196	54	54	151	5,140	1,450
29	2,200	.....	526	526	802	196	172	54	152	151	4,000	1,550
30	1,980	.....	526	526	1,550	196	151	54	196	151	3,430	1,550
31	1,980	.....	728	.....	1,450	.....	151	54	.....	405	.....	1,650

NOTE.—These discharges are based on a rating curve that is fairly well defined between 65 and 15,000 second-feet.

Monthly discharge of Coast Fork of Willamette River near Goshen, Oreg., for 1909.

[Drainage area 690 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	24,400	1,650	7,280	10.6	12.22	448,000	B.
February	9,200	1,980	4,120	5.97	6.22	229,000	B.
March	6,010	465	2,170	3.14	3.62	133,000	B.
April	1,980	295	684	.991	1.11	40,700	B.
May	1,550	348	539	.781	.90	33,100	B.
June	1,450	196	415	.600	.67	24,700	B.
July	655	112	238	.345	.40	14,600	B.
August	151	54	80.5	.117	.13	4,950	C.
September	196	54	62.0	.090	.10	3,690	C.
October	526	112	216	.313	.36	13,300	B.
November	31,300	196	4,820	6.99	7.80	287,000	B.
December	9,600	1,450	3,480	5.04	5.81	214,000	B.
The year	31,300	54	2,010	2.91	39.34	1,450,000	

M'KENZIE RIVER NEAR SPRINGFIELD, OREG.

This station was established September 12, 1905, and has been maintained continuously since that date. It is located at Hendricks Ferry—an old river crossing that was replaced by a highway bridge in 1908—11 miles above Springfield, 3 miles below Waterville, 4 miles above Thurston, Oreg., and 3 miles above the mouth of Camp Creek.

The results obtained at this station have considerable economic value, as it is probable that this river will be extensively used for

both irrigation and water power. The station also furnishes data for determining run-off factors from heavily forested areas with high rainfall.

The vertical staff gage is spiked to a small willow tree on the left bank about 250 feet above the cable station. Discharge measurements are made from a cable equipment. Those taken during high water in the past are not very reliable. Individual measurements at low and medium stages can be made with accuracy. No measurements were made during 1909.

The conditions at this station do not favor accurate results. The stream is extensively used for floating logs during all seasons of the year, and the gage records have been greatly influenced thereby. Individual daily records may be greatly in error, although it is probable that this error diminishes rapidly as records of longer periods are considered.

Daily gage height, in feet, of McKenzie River near Springfield, Oreg., for 1909.

[N. M. Hendricks, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2.5	2.7	3.8	2.7	2.35	3.6	1.7	1.4	1.2	1.4	2.45	5.4
2	2.3	2.6	3.3	2.9	2.35	3.5	1.7	1.4	1.15	1.35	2.8	5.9
3	2.7	2.75	4.1	2.9	2.5	3.45	1.65	1.45	1.1	1.3	3.75	4.0
4	4.3	2.75	3.95	2.85	2.8	3.25	1.65	1.4	1.1	1.3	2.5	3.7
5	4.6	2.75	3.6	2.6	2.9	2.9	1.65	1.4	1.1	1.2	2.05	3.65
6	4.15	2.65	3.4	2.5	2.5	2.8	2.4	1.35	1.1	1.2	2.05	3.5
7	5.3	2.55	3.2	2.4	2.45	2.6	2.25	1.3	1.1	1.15	2.0	3.4
8	4.95	2.45	3.25	2.35	2.4	2.5	1.95	1.3	1.1	1.1	2.0	3.5
9	4.1	2.5	3.2	2.4	2.5	2.5	1.8	1.35	1.1	1.1	2.0	3.5
10	3.45	2.5	3.1	2.4	2.5	2.5	1.75	1.35	1.1	1.05	2.3	3.8
11	3.2	2.45	2.85	2.35	2.45	2.4	1.7	1.3	1.1	1.05	2.5	5.4
12	2.9	2.6	2.8	2.3	2.4	2.4	1.7	1.3	1.1	1.05	2.6	5.5
13	2.8	3.0	2.75	2.2	2.4	2.3	1.65	1.3	1.1	1.05	2.5	6.1
14	2.8	3.1	2.75	2.25	2.3	2.25	1.65	1.3	1.1	1.05	2.0	6.0
15	4.5	3.6	2.7	2.3	2.3	2.15	1.6	1.3	1.1	1.05	1.9	5.4
16	6.35	4.5	2.9	2.3	2.3	2.2	1.6	1.3	1.1	1.05	1.7	5.1
17	4.25	5.6	3.0	2.2	2.3	2.15	1.6	1.3	1.1	1.05	2.7	4.0
18	6.3	5.2	2.75	2.2	2.3	2.1	1.55	1.3	1.1	1.05	5.35	3.5
19	6.7	4.7	2.75	2.2	2.35	2.0	1.5	1.3	1.1	1.2	7.3	3.4
20	8.2	4.5	2.6	2.2	2.35	1.9	1.5	1.3	1.1	1.3	7.3	3.15
21	7.7	3.9	2.5	2.1	2.4	1.9	1.45	1.3	1.1	1.45	4.95	3.1
22	6.35	3.6	2.45	2.1	2.5	1.8	1.45	1.3	1.1	1.2	10.8	2.8
23	5.05	3.35	2.4	2.1	2.0	1.8	1.45	1.4	1.1	1.2	11.2	2.6
24	4.45	4.0	2.35	2.1	2.0	1.8	1.4	1.5	1.1	1.1	8.7	2.6
25	4.0	3.6	2.3	2.1	2.0	1.8	1.4	1.5	1.05	1.1	6.7	2.5
26	3.6	3.4	2.3	2.1	2.3	1.8	1.4	1.6	1.05	1.2	5.4	2.5
27	3.4	3.0	2.35	2.25	2.5	1.75	1.4	1.6	1.05	1.25	4.75	2.5
28	3.2	3.9	2.4	2.4	3.1	1.75	1.4	1.2	1.1	1.4	5.1	2.5
29	3.1	.....	2.4	2.5	3.2	1.7	1.5	1.2	1.3	1.5	5.1	2.6
30	2.95	.....	2.45	2.35	3.5	1.7	1.4	1.2	1.4	1.5	5.5	2.8
31	2.8	.....	2.45	.....	3.6	.....	1.4	1.2	.....	2.45	.....	2.8

NOTE.—Gage heights during the summer months may have been affected by logging operations.

Daily discharge, in second-feet, of McKenzie River near Springfield, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	4,500	4,940	7,770	4,940	4,180	7,190	2,940	2,450	2,180	2,450	4,390	12,800
2	4,080	4,720	6,340	5,380	4,180	6,900	2,940	2,450	2,120	2,380	5,160	14,600
3	4,940	5,050	8,650	5,380	4,500	6,760	2,860	2,520	2,050	2,310	7,620	8,350
4	9,270	5,050	8,200	5,270	5,160	6,210	2,860	2,450	2,050	2,310	4,500	7,480
5	10,200	5,050	7,190	4,720	5,380	5,380	2,860	2,450	2,050	2,180	3,580	7,340
6	8,800	4,830	6,620	4,500	4,500	5,160	4,280	2,380	2,050	2,180	3,580	6,900
7	12,500	4,610	6,080	4,280	4,390	4,720	3,980	2,310	2,050	2,120	3,480	6,620
8	11,300	4,390	6,210	4,180	4,280	4,500	3,390	2,310	2,050	2,050	3,480	6,900
9	8,650	4,500	6,080	4,280	4,500	4,500	3,120	2,380	2,050	2,050	3,480	6,900
10	6,760	4,500	5,840	4,280	4,500	4,500	3,030	2,380	2,050	1,990	4,080	7,770
11	6,080	4,390	5,270	4,180	4,390	4,280	2,940	2,310	2,050	1,990	4,500	12,800
12	5,380	4,720	5,160	4,080	4,280	4,280	2,940	2,310	2,050	1,990	4,720	13,200
13	5,160	5,600	5,050	3,880	4,280	4,080	2,860	2,310	2,050	1,990	4,500	15,300
14	5,160	5,840	5,050	3,980	4,080	3,980	2,860	2,310	2,050	1,990	3,480	14,900
15	9,900	7,190	4,940	4,080	4,080	3,780	2,770	2,310	2,050	1,990	3,300	12,800
16	16,200	9,900	5,380	4,080	4,080	3,880	2,770	2,310	2,050	1,990	2,940	11,800
17	9,120	13,500	5,600	3,880	4,080	3,780	2,770	2,310	2,050	1,990	4,940	8,350
18	16,000	12,200	5,050	3,880	4,080	3,680	2,680	2,310	2,050	1,990	12,700	6,900
19	17,400	10,500	5,050	3,880	4,180	3,480	2,600	2,310	2,050	2,180	19,700	6,620
20	23,300	9,900	4,720	3,880	4,180	3,300	2,600	2,310	2,050	2,310	19,700	5,960
21	21,300	8,060	4,500	3,680	4,280	3,300	2,520	2,310	2,050	2,520	11,300	5,840
22	16,200	7,190	4,390	3,680	4,500	3,120	2,520	2,310	2,050	2,180	33,700	5,160
23	11,700	6,480	4,280	3,680	3,480	3,120	2,520	2,450	2,050	2,180	35,400	4,720
24	9,740	8,350	4,180	3,680	3,480	3,120	2,450	2,600	2,050	2,050	25,300	4,720
25	8,350	7,190	4,080	3,680	3,480	3,120	2,450	2,600	1,990	2,050	17,400	4,500
26	7,190	6,620	4,080	3,680	4,080	3,120	2,450	2,770	1,990	2,180	12,800	4,500
27	6,620	5,600	4,180	3,980	4,500	3,030	2,450	2,770	1,990	2,240	10,700	4,500
28	6,080	8,060	4,280	4,280	5,840	3,030	2,450	2,180	2,050	2,450	11,800	4,500
29	5,840	.....	4,280	4,500	6,080	2,940	2,600	2,180	2,310	2,600	11,800	4,720
30	5,490	.....	4,390	4,180	6,900	2,940	2,450	2,180	2,450	2,600	13,200	5,160
31	5,160	.....	4,390	.....	7,190	.....	2,450	2,180	.....	4,390	.....	5,160

NOTE.—These discharges are based on a rating curve that is fairly well defined between 3,500 and 15,000 second-feet.

Monthly discharge of McKenzie River near Springfield, Oreg., for 1909.

[Drainage area 960 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	23,300	4,080	9,620	10.0	11.53	592,000	B.
February	13,500	4,390	6,750	7.03	7.32	375,000	B.
March	8,650	4,080	5,400	5.62	6.48	332,000	B.
April	5,380	3,680	4,200	4.38	4.89	250,000	B.
May	7,190	3,480	4,550	4.74	5.46	280,000	B.
June	7,190	2,940	4,170	4.34	4.84	248,000	B.
July	4,280	2,450	2,820	2.94	3.39	173,000	C.
August	2,770	2,180	2,380	2.48	2.86	146,000	C.
September	2,450	1,990	2,070	2.16	2.41	123,000	C.
October	4,390	1,990	2,250	2.34	2.70	138,000	C.
November	35,400	2,940	10,200	10.6	11.83	607,000	B.
December	15,300	4,500	8,000	8.33	9.6	492,000	B.
The year	35,400	1,990	5,200	5.41	73.31	3,760,000	

SANTIAM RIVER DRAINAGE BASIN.

MARION FORK OF SANTIAM RIVER AT MARION LAKE, NEAR DETROIT, OREG.

This station was established February 23, 1907, by J. G. Kelley, of Portland, Oreg., who furnished the records. It is located about 200 feet below the outlet of Marion Lake, 30 miles from Detroit, Oreg., from which it is reached by trail.

The gage heights for 1907 were obtained by measuring down from a reference point. From January to July, 1909, the gage used recorded maximum and minimum stages between observations. On August 1, 1909, a 15-foot rectangular weir was installed from which the discharges were determined until November 20, 1909, when it was washed away. These discharges have not been published as they are thought to be too small.

No discharge measurements have been made at this station since 1907.

The results obtained at this station will be of value in connection with the development of water powers on this stream.

Maximum, minimum, and daily gage heights, in feet, of Marion Fork of Santiam River near Detroit, Oreg., for 1909.

[J. G. Kelley, observer.]

Date.	Gage height.		
	Maximum.	Minimum.	Daily.
Prior to Jan. 28, 1909	6.16	5.57	
Jan. 28			5.82
Jan. 29			5.82
Jan. 30 to Feb. 24	6.0	5.67	
Feb. 25			6.0
Feb. 26			6.0
Feb. 27			6.0
Feb. 28 to Mar. 26	6.0	5.58	
Mar. 27			5.83
Mar. 28 to 31	5.83	5.83	
Apr. 1			5.83
Apr. 2 to 25	6.38	5.75	
Apr. 26			6.08
Apr. 27 to 30	6.38	6.16	
May 1			6.16
May 2			6.5
May 3 to 7	6.5	6.38	
May 8			6.38
May 9	6.38	6.07	
May 10			6.07
May 11 to 30	7.0	6.38	
May 31			7.0
June 1 to 8	7.25	6.38	
June 9			6.42
June 10 to 12	6.42	6.25	
June 13			6.38
June 14 to 19	6.42	6.25	
June 20			6.25
June 21 to 29	6.25	5.92	
June 30			5.92
July 1 to 18	5.82	5.58	
July 19			5.58

NOTE.—These records were secured by means of a maximum-minimum gage. See description.

NORTH FORK OF SANTIAM RIVER NEAR DETROIT, OREG.

This station was established January 24, 1907, by J. G. Kelley, of Portland, who has cooperated with the Survey in its maintenance. The station is located at a footbridge 1 mile above Detroit, Oreg., about 1½ miles above the mouth of Britenbush Creek, and 2 miles below the mouth of Bowlder Creek.

The records are of particular use in furnishing data for the development of water power, for which this stream is exceptionally valuable.

As the low-water flow is the value specifically sought, no particular effort has been made to determine the flood discharge, and only the low-water records have been computed.

The station was discontinued October 31, 1909, in favor of another several miles upstream, where gaging conditions are better.

No discharge measurements were made during 1909, and no estimates of discharge are permissible with the data available. The 1907–8 rating curve is not applicable.

Daily gage height, in feet, of North Fork of Santiam River near Detroit, Oreg., for 1909.

[Emma J. Lindis, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.
1	2.8	2.5	2.8	2.6	2.8	3.9	1.7	1.5	0.6	0.8
2	1.95	2.5	2.7	2.7	2.95	4.05	1.7	1.4	.6	.7
3	3.15	2.4	2.7	2.85	3.6	3.8	1.6	1.3	.6	.6
4	3.35	2.4	2.7	2.85	3.95	3.65	1.65	1.3	.6	.5
5	3.3	2.4	2.7	2.8	3.6	3.50	1.9	1.3	.6	.5
6	3.2	2.3	2.6	2.8	3.0	3.05	2.1	1.3	.5	.6
7	3.3	2.3	2.6	2.65	3.0	2.9	2.0	1.3	.5	.7
8	3.2	2.2	2.5	2.6	3.0	2.8	2.15	1.2	.5	.8
9	3.1	2.2	2.5	2.5	2.9	2.75	2.3	1.2	.6	.9
10	2.8	2.1	2.4	2.5	2.7	2.7	2.10	1.2	.6	1.0
11	2.25	2.1	2.4	2.5	2.7	2.7	2.0	1.1	.6	1.0
12	2.2	2.3	2.3	2.5	2.8	2.6	1.9	1.0	.55	1.0
13	2.2	2.4	2.2	2.5	2.95	2.6	1.8	1.0	.4	.9
14	2.35	2.4	2.2	2.5	2.9	2.55	1.8	1.0	.5	.9
15	2.85	2.4	2.3	2.4	2.85	2.5	1.7	1.0	.65	.9
16	5.25	3.7	2.5	2.45	2.8	2.55	1.6	1.0	.8	.9
17	4.8	4.65	2.5	2.5	2.7	2.5	1.6	1.0	.9	.9
18	5.8	4.9	2.5	2.4	2.65	2.4	1.5	1.0	.9	.9
19	7.2	4.8	2.6	2.4	2.6	2.4	1.5	1.0	.9	1.0
20	8.0	4.35	2.35	2.4	2.6	2.35	1.5	1.0	1.0	1.1
21	7.4	3.5	2.3	2.4	2.6	2.2	1.5	1.0	1.0	1.1
22	6.05	3.4	2.3	2.4	2.5	2.2	1.45	1.0	1.2	1.1
23	5.0	3.15	2.3	2.4	2.4	2.1	1.4	1.0	1.0	1.1
24	4.85	3.0	2.25	2.45	2.45	2.1	1.4	1.0	.9	1.1
25	4.25	2.9	2.3	2.5	2.65	2.0	1.5	.9	.8	1.0
26	3.5	2.9	2.4	2.9	2.9	2.0	1.5	.9	.65	1.0
27	3.0	2.8	2.5	3.6	3.35	2.0	1.6	.8	.6	1.05
28	2.9	2.8	2.5	3.6	3.35	2.0	1.5	.8	.7	1.15
29	2.8	.....	2.6	3.35	3.4	1.9	1.5	.7	.7	1.3
30	2.6	.....	2.6	2.85	3.65	1.8	1.5	.7	.8	1.65
31	2.5	.....	2.5	.....	3.7	.....	1.5	.6	.....	2.05

SANTIAM RIVER AT JEFFERSON, OREG.

This station was established July 19, 1905, and was discontinued July 1, 1906, but was reestablished October 15, 1908. It is located at Jefferson, Oreg., 2½ miles below the junction of the North and South forks, measurements being made either from the highway bridge or from the Southern Pacific Railroad bridge. It is 9 miles above the mouth of the stream and below all tributaries.

The stream is particularly valuable for its water powers, although it seems probable that extensive use will be made of its waters for irrigation in the near future. The stream system is composed of two very dissimilar branches, the North and South forks. The total annual amount contributed by each fork is approximately the same, but the flow of the South Fork is very irregular, falling very low in the summer time and being subject to excessive and violent floods. The

North Fork, on the other hand, maintains a well-established flow during the low-water season.

The original staff gage was located on a pier of the railroad bridge. It was impossible to obtain even approximate heights during flood stages. The records obtained prior to July 1, 1906, are not reliable. Since this station was established, October 15, 1908, the gage installed by the Jefferson Mill Co. was used. It is located at the mill just above the bridge, where accurate gage heights can be obtained. This gage is at the same datum as the old gage. The United States Weather Bureau gage that is on the middle pier of the railroad bridge is also at the same datum.

Sufficient data are not at present available for an accurate determination of daily and monthly discharge.

Discharge measurements of Santiam River at Jefferson, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Jan. 16	Howard Kimble	550	7,500	10.33	47,100
16	do	550	8,140	11.67	53,700
17	do	500	5,700	7.79	34,900

Daily gage height, in feet, of Santiam River at Jefferson, Oreg., for 1909.

[A. J. Shumaker and S. A. Pease, observers.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	3.50	3.50	.....	4.50	3.25	4.75	1.33	.....	0.50	1.40	5.20	7.30
2	3.42	3.25	7.50	4.50	.....	4.42	1.33	1.05	.50	1.10	5.60	6.40
3	.....	3.83	6.25	4.08	3.25	3.92	1.25	.95	.50	.....	7.50	5.50
4	6.17	3.92	6.17	.....	3.75	3.50	.....	.90	.50	.75	5.10	4.80
5	6.17	3.83	5.50	3.67	3.75	3.42	1.17	.85	.....	.70	4.20	.....
6	5.92	3.67	4.92	3.58	3.75	.....	1.75	.85	.50	.70	3.80	4.20
7	7.25	.....	.....	3.42	2.83	2.92	3.42	.80	.50	.90	.....	4.00
8	8.00	3.42	4.33	3.25	2.50	2.83	2.50	.....	.45	.80	3.20	4.00
9	6.00	3.33	4.75	3.25	.....	2.67	2.00	.80	.45	.80	4.20	5.80
10	.....	3.33	4.25	3.25	2.75	2.42	1.67	.80	.45	.....	4.80	5.60
11	4.50	3.33	3.92	.....	3.08	2.42	.....	.75	.45	.70	5.20	4.90
12	3.50	3.33	3.75	3.08	3.25	2.33	1.95	.75	.....	.60	4.20	.....
13	3.50	3.33	3.50	2.92	3.00	.....	1.70	.70	.45	.55	3.90	8.60
14	3.25	.....	.....	2.92	2.75	2.17	1.55	.70	.45	.55	.....	7.40
15	5.30	4.50	3.42	2.83	2.67	2.00	1.45	.....	.45	.55	3.2	6.20
16	10.50	6.46	3.42	2.75	.....	2.00	1.35	.70	.40	.50	2.90	5.50
17	8.30	6.88	3.75	2.75	2.67	2.00	1.30	.65	.40	.....	2.70	4.80
18	9.50	7.33	3.83	.....	2.58	.....	.....	.60	.40	.50	4.20	4.40
19	9.40	7.00	3.50	2.67	2.50	.....	1.20	.60	.....	.50	7.80	.....
20	11.90	6.83	3.42	2.58	2.50	.....	1.15	.60	.40	.80	12.80	3.10
21	10.70	.....	.....	2.42	2.50	1.67	1.10	.....	.45	1.80	8.50	3.06
22	9.20	5.38	3.08	2.33	2.92	.....	1.05	.....	.60	2.00	12.60	3.04
23	7.00	4.75	3.00	2.25	.....	.....	1.00	.55	.55	1.60	16.50	3.00
24	.....	4.75	2.83	2.25	2.75	.....	1.00	.55	.50	.....	15.10	3.00
25	5.50	6.17	2.75	.....	2.83	.....	.....	.55	.50	1.10	11.00	2.90
26	5.00	5.50	2.83	2.33	2.92	.....	1.05	.50	.....	1.00	8.00	.....
27	4.50	5.08	3.00	2.92	3.50	1.50	1.40	.50	.50	1.00	6.20	2.70
28	4.00	.....	.....	4.42	4.08	1.42	1.35	.50	.50	.90	.....	2.60
29	3.75	.....	3.25	3.75	4.50	1.33	1.25	.....	.50	.90	6.60	2.50
30	3.50	.....	3.33	3.25	.....	1.33	1.15	.50	1.00	1.60	9.30	2.40
31	.....	.....	3.42	.....	5.42	.....	1.05	.50	.....	.....	.....	2.40

PUZZLE CREEK NEAR DETROIT, OREG.

A station on this stream was established at its mouth in February, 1907, by J. G. Kelley, of Portland, who has cooperated with the United States Geological Survey in its maintenance. The gage heights were obtained by measuring down from a reference point, which had an assumed elevation of 10 feet. On August 6, 1909, 6-foot rectangular weirs were installed on North and South forks of Puzzle Creek and were used to obtain the discharge until the November flood, when both weirs were washed out. The results obtained on both forks have been added, but are not comparable with those obtained at the mouth of the stream on account of intermediate drainage.

The data obtained at this station are valuable principally for use in development of water power.

No current-meter measurements have been made at this station since 1907.

Observed discharges on Puzzle Creek near Detroit, Oreg., in 1909.

Date.	North Fork (6-foot weir).		South Fork (6-foot weir).		Total discharge.
	Head.	Discharge.	Head.	Discharge.	
	Feet.	*Sec.-ft.*	*Feet.*	*Sec.-ft.*	*Sec.-ft.*
Aug. 1	0.58	8.7	1.12	22.9	31.6
4	.58	8.7	1.14	23.5	32.2
19	.58	8.7	1.14	23.5	32.2
29	.56	8.2	1.08	21.7	29.9
Sept. 15	.58	8.7	1.08	21.7	30.4
29	.56	8.2	.92	17.0	25.2
Oct. 3	.56	8.2	.92	17.0	25.2
7	.56	8.3	.88	15.8	24.1
13	.56	8.3	.88	15.8	24.1
17	.54	7.8	.92	17.0	24.8
20	.54	7.8	.87	15.8	23.6
24	.52	7.4	.83	14.7	22.1
27	.52	7.4	.75	12.6	20.0
31	.50	7.0	.75	12.6	19.6
Nov. 3	.50	7.0	.75	12.6	19.6
11	.54	7.8	.83	14.7	22.5
16	.63	9.7	1.00	19.3	29.0
19	2.17	60.0	2.00	52.0	112.0
23	2.09	53.0	1.67	41.0	94.0
Dec. 31	.85	15.2	.92	17.0	32.2

Monthly discharge of Puzzle Creek near Detroit, Oreg., for 1909.

Month.	Mean discharge, in second-feet.	Total run-off in acre-feet.
August	31.2	1,920
September	28.7	1,710
October	23.3	1,430
November 1–19	32.7	1,230

NOTE.—These estimates are based on the combined flow over a 6-foot weir on the North Fork and one on the South Fork, daily discharges for missing days being interpolated. The leakage through weirs, velocity of approach, and possible roundness of crests have been neglected. If any of these have any effect, the discharges as given are too small.

PERMELIA CREEK NEAR DETROIT, OREG.

This station was established February 23, 1907. It is located at the Minto trail crossing in sec. 33, T. 10 S., R. 7 E., about one-half mile above the mouth of the stream. The station has been maintained by J. G. Kelley, of Portland, Oreg., who furnishes the records.

The data are valuable principally in connection with a general study of the possibilities for water-power development on the North Fork of Santiam River. The gage heights are obtained by measuring down from a reference point, which is a spike in a 6-inch alder on the left bank 30 feet upstream from the trail crossing.

No discharge measurements were made during 1909.

Daily gage height, in feet, and discharge, in second-feet, of Permelia Creek near Detroit, Oreg., for 1907.

Date.	Gage height.	Discharge.	Date.	Gage height	Discharge.	Date.	Gage height.	Discharge.
Feb. 5	7.58	787	Apr. 26	5.33	173	July 16	6.19	358
23	5.42	190	May 11	5.33	173	Aug. 9	5.0	114
26	5.38	182	13	5.21	152	11	5.0	114
Mar. 5	5.12	136	24	5.3	168	Sept. 18	4.89	94
8	5.1	132	26	5.18	147	Oct. 3	4.92	100
15	5.04	121	June 4	5.25	159	6	4.89	94
18	5.12	136	6	5.25	159	22	4.83	85
30	5.66	236	17	5.1	132	24	4.83	85
Apr. 12	5.62	228	20	5.1	132	Nov. 11	4.83	85
15	5.54	212	July 2	5.21	152	13	4.83	85
24	5.41	188	5	5.21	152			

Daily gage height, in feet, and discharge, in second-feet, of Permelia Creek near Detroit, Oreg., for 1909.

Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.	Date.	Gage height.	Discharge.
Jan. 27	5.25	159	May 1	5.17	145	June 15	5.25	159
30	5.25	159	2	5.25	159	30	5.17	145
Feb. 24	5.33	173	4	5.17	145	July 16	5.16	143
27	5.33	173	8	5.33	173	Oct. 9	4.75	72
Mar. 27	5.25	159	10	5.25	159	22	4.92	100
Apr. 1	5.33	173	31	5.33	173	Nov. 8	5.0	114
26	5.25	159	June 9	5.25	159	24	7.75	855

NOTE.—The daily discharges are based on a rating curve that is fairly well defined between 80 and 130 second-feet.

LUCKIAMUTE RIVER NEAR SUVER, OREG.

This station was established August 18, 1905, and has been maintained continuously since that date. It is located just below Helmick bridge on the public highway, 4 miles northwest of Suver, Oreg., 4 miles south of Monmouth, and 3 miles below the junction of the North and South forks.

The staff gage is in two sections; the lower is an inclined rod drift-bolted to a bridge post. The upper portion is vertical and nailed to a bridge timber. Discharge measurements are made from a cable equipment.

The results furnish data valuable in the general study of run-off from the forested areas of the eastern slope of the Coast Range and are comparable in a general way with the records on Yamhill River. The river is subject to excessive and violent floods, due to the sudden melting of snows on the mountain slopes. At the station the river flows in a comparatively deep canyon and the records are believed to be reliable. No discharge measurements were made during 1909. It is believed that no changes occurred during the year to alter the rating.

Daily gage height, in feet, of Luckiamute River near Suver, Oreg., for 1909.

[Mrs. P. C. Bush, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	10.9	8.5	15.3	7.8	3.6	5.2	2.2	1.55	1.4	1.85	10.0	21.5
2	11.5	9.8	15.0	7.3	3.55	5.0	2.26	1.6	1.35	1.9	12.0	19.0
3	13.5	11.9	14.5	6.4	3.5	4.25	2.1	1.55	1.3	1.9	15.6	17.5
4	12.0	13.5	13.9	6.1	3.6	4.0	2.1	1.55	1.3	1.85	15.0	15.5
5	11.5	14.0	12.5	5.7	3.55	3.6	2.4	1.55	1.3	1.75	14.0	13.6
6	10.9	16.5	11.0	5.4	3.4	3.3	2.9	1.5	1.3	1.6	14.5	10.5
7	10.6	14.9	10.5	5.1	3.2	3.3	3.0	1.5	1.3	1.55	15.0	13.5
8	10.5	13.2	10.8	5.0	3.2	3.6	3.2	1.5	1.3	1.5	15.8	15.0
9	9.9	13.0	10.7	4.9	3.25	3.7	3.3	1.5	1.35	1.5	16.0	18.3
10	9.6	14.8	10.9	4.9	3.25	3.8	3.4	1.45	1.35	1.45	15.5	20.8
11	9.0	14.7	10.0	4.7	3.3	3.8	3.0	1.45	1.35	1.4	15.0	21.0
12	8.6	14.0	9.3	4.5	3.3	3.75	2.85	1.4	1.3	1.4	14.0	26.5
13	8.0	14.5	8.6	4.4	3.35	3.7	2.6	1.4	1.3	1.4	12.5	22.5
14	7.5	16.7	8.1	4.2	3.35	3.7	2.15	1.4	1.25	1.4	10.0	19.6
15	11.0	18.3	7.8	4.2	3.4	3.0	2.1	1.4	1.25	1.4	8.0	16.8
16	14.5	19.0	7.6	4.3	3.2	3.5	2.0	1.4	1.2	1.4	12.0	14.5
17	18.5	23.8	7.3	4.25	3.2	2.7	2.0	1.3	1.0	1.45	13.5	13.0
18	24.7	23.0	7.1	4.3	3.3	2.75	1.95	1.35	1.0	1.0	14.0	10.9
19	28.4	23.2	6.7	4.2	3.2	2.8	1.9	1.3	1.0	2.0	16.0	9.5
20	27.5	20.4	6.6	4.15	3.1	2.75	1.85	1.4	1.2	2.5	24.0	9.0
21	27.0	18.1	6.5	4.1	3.0	2.65	1.85	1.45	1.2	2.5	19.3	8.7
22	25.7	17.8	6.3	4.0	2.9	2.6	1.8	1.4	1.2	2.55	25.7	8.0
23	22.5	14.7	6.0	3.95	2.8	2.55	1.8	1.4	1.25	2.55	28.8	7.8
24	18.3	14.3	5.7	3.9	2.8	2.31	1.75	1.4	1.3	2.55	27.5	7.4
25	15.5	17.8	5.5	4.0	2.8	2.31	1.65	1.4	1.3	2.5	25.4	7.1
26	12.5	16.3	5.45	4.2	2.8	2.3	1.6	1.4	1.3	2.0	20.35	7.0
27	11.7	16.7	5.4	4.2	2.9	2.3	1.55	1.4	1.35	2.0	14.4	6.5
28	10.5	15.1	5.5	4.0	2.9	2.3	1.4	1.4	1.5	2.5	19.8	6.0
29	10.0	.....	5.2	3.9	6.5	2.2	1.3	1.4	1.55	2.5	20.3	6.1
30	8.3	.....	5.3	3.85	6.0	2.25	1.35	1.4	1.6	2.55	25.5	6.3
31	7.8	.....	7.0	.....	5.45	.....	1.4	1.4	.....	6.0	.....	6.5

Daily discharge, in second-feet, of Luckiamute River near Suver, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,660	1,120	2,870	980	293	515	133	80	69	103	1,440	5,110
2	1,800	1,400	2,780	880	286	485	139	83	66	107	1,930	4,110
3	2,340	1,900	2,620	715	280	378	124	80	62	107	2,960	3,580
4	1,930	2,340	2,450	662	293	345	124	80	62	103	2,780	2,930
5	1,800	2,480	2,060	592	286	293	153	80	62	95	2,480	2,360
6	1,660	3,250	1,680	545	267	254	206	76	62	83	2,620	1,560
7	1,580	2,740	1,560	500	242	254	218	76	62	80	2,780	2,340
8	1,560	2,260	1,630	485	242	293	242	76	62	76	3,020	2,775
9	1,420	2,200	1,610	470	248	306	254	76	66	76	3,080	3,860
10	1,350	2,720	1,660	470	248	319	267	72	66	72	2,930	4,820
11	1,220	2,680	1,440	440	254	319	218	72	66	69	2,780	4,900
12	1,140	2,480	1,290	411	254	312	200	69	62	69	2,480	7,520
13	1,020	2,620	1,140	397	260	306	173	69	62	69	2,060	5,540
14	920	3,370	1,040	371	260	306	128	69	59	69	1,440	4,340
15	1,680	3,860	980	371	267	218	124	69	59	69	1,020	3,340

Daily discharge, in second-feet, of Luckiamute River near Suver, Oreg., for 1909—Contd.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	2,620	4,110	940	384	242	280	115	69	56	69	1,930	2,620
17	3,930	6,150	880	378	242	184	115	62	44	72	2,340	2,200
18	6,590	5,770	840	384	254	190	111	66	44	44	2,480	1,660
19	8,540	5,860	768	371	242	195	107	62	44	115	3,080	1,330
20	8,050	4,650	750	364	230	190	103	69	56	163	6,240	1,220
21	7,780	3,790	732	358	218	178	103	72	56	163	4,220	1,160
22	7,100	3,680	698	345	206	173	99	69	56	168	7,100	1,020
23	5,540	2,680	645	338	195	168	99	69	59	168	8,770	980
24	3,860	2,560	592	332	195	144	95	69	62	168	8,050	900
25	2,930	3,680	560	345	195	144	87	69	62	163	6,940	840
26	2,060	3,180	552	371	195	143	83	69	62	115	4,630	820
27	1,860	3,310	545	371	206	143	80	69	66	115	2,600	732
28	1,560	2,810	560	345	206	143	69	69	76	163	4,410	645
29	1,440	.....	515	332	732	133	62	69	80	163	4,610	662
30	1,080	.....	530	326	645	138	66	69	83	168	7,000	698
31	980	.....	820	.....	552	.....	69	69	.....	645	.....	732

NOTE.—These discharges are based on a rating curve that is well defined between 60 and 4,500 second-feet.

Monthly discharge of Luckiamute River near Suver, Oreg., for 1909.

[Drainage area, 233 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	8,540	920	2,870	12.3	14.18	176,000	A.
February	6,150	1,120	3,200	13.7	14.27	178,000	A.
March	2,870	515	1,220	5.24	6.04	75,000	A.
April	980	326	454	1.95	2.18	27,000	A.
May	732	195	282	1.21	1.40	17,300	A.
June	515	133	248	1.06	1.18	14,800	A.
July	267	62	134	.575	.66	8,240	A.
August	83	62	71.5	.307	.35	4,400	B.
September	83	44	61.8	.265	.39	3,680	B.
October	645	44	126	.541	.62	7,750	B.
November	8,770	1,020	3,670	15.8	17.63	218,000	A.
December	7,520	645	2,490	10.7	12.34	153,000	A.
The year	8,770	44	1,240	5.30	71.15	883,000	

YAMHILL RIVER DRAINAGE BASIN.

SOUTH FORK OF YAMHILL RIVER AT SHERIDAN, OREG.

This station was established April 25, 1906. It is located at the highway bridge in Sheridan, Oreg., 2 miles below the mouth of Mill Creek. It was discontinued June 30, 1909, for lack of an observer.

The records determine in a general way the run-off from the eastern slope of the Coast Range and are particularly valuable in the study of forestry and run-off conditions. It is also probable that the waters will be used in the near future for irrigation.

The staff gage is attached to the right bridge pier.

No change in gage datum has occurred since the station was established. Discharge measurements are made from the highway bridge. The records are believed to be fairly reliable, although the conditions are not ideal. The banks of the river are densely covered with willows and brush that render the accurate determination of flood discharge difficult.

No discharge measurements were made during 1909.

Daily gage height, in feet, of South Fork of Yamhill River at Sheridan, Oreg., for 1909.

[W. Tyler Smith, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	5.5	5.0	6.4	3.0	1.0	0.9	16	13.0	11.6	3.1	1.2	1.0	0.9
2	5.0	11.0	6.0	3.0	1.0	0.9	17	10.2	14.0	3.2	1.2	1.0	0.9
3	4.5	12.4	5.3	3.0	1.0	0.9	18	12.0	12.5	3.15	1.2	1.0	0.8
4	4.0	12.0	5.0	1.8	1.0	0.9	19	18.1	9.0	3.0	1.2	1.0	0.8
5	4.0	11.7	4.3	1.8	1.0	0.9	20	14.3	8.0	3.0	1.0	1.0	0.8
6	4.3	8.0	4.6	1.8	1.0	0.9	21	13.3	8.5	3.0	1.0	0.9	0.8
7	3.9	7.5	4.5	1.8	1.0	0.9	22	10.6	7.3	3.0	1.0	0.9	0.9
8	3.0	7.0	4.0	1.6	1.0	0.9	23	6.5	7.0	3.1	1.0	0.9	0.9
9	2.2	7.0	4.0	1.6	1.1	0.9	24	6.4	7.0	3.1	1.0	0.9	0.9
10	2.0	6.7	3.9	1.6	1.1	0.9	25	6.0	6.4	3.1	1.0	0.9	0.9
11	1.8	6.0	3.7	1.4	1.1	0.9	26	6.0	6.7	3.1	1.0	0.9	0.9
12	1.8	5.7	3.5	1.4	1.1	0.9	27	5.9	6.2	3.1	1.0	0.9	0.9
13	4.3	5.0	3.5	1.4	1.0	0.9	28	5.7	6.4	3.1	1.0	0.9	0.9
14	8.6	5.0	3.4	1.4	1.0	0.9	29	5.7	.....	3.1	1.0	0.9	0.9
15	10.4	5.8	3.4	1.2	1.0	0.9	30	5.4	.....	3.5	1.0	0.9	0.9
							31	5.5	.....	3.0	.....	0.9	.....

Daily discharge, in second-feet, of South Fork of Yamhill River at Sheridan, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	2,920	2,470	3,790	980	178	152	16	11,400	9,650	1,040	234	178	152
2	2,470	8,920	3,390	980	178	152	17	7,960	12,000	1,100	234	178	152
3	2,050	10,000	2,740	980	178	152	18	10,200	10,800	1,070	234	178	127
4	1,660	10,200	2,470	428	178	152	19	17,900	6,500	980	234	178	127
5	1,660	9,780	1,890	428	178	152	20	13,000	5,450	980	178	178	127
6	1,890	5,450	2,130	428	178	152	21	11,800	6,000	980	178	152	127
7	1,580	4,900	2,050	428	178	152	22	8,440	4,690	980	178	152	152
8	980	4,390	1,660	359	178	152	23	3,890	4,390	1,040	178	152	152
9	580	4,390	1,060	359	205	152	24	3,790	4,390	1,040	178	152	152
10	500	4,090	1,580	359	205	152	25	3,390	3,790	1,040	178	152	152
11	428	3,390	1,440	294	205	152	26	3,390	4,090	1,040	178	152	152
12	428	3,100	1,300	294	205	152	27	3,300	3,590	1,040	178	152	152
13	1,890	2,470	1,300	294	178	152	28	3,100	3,790	1,040	178	152	152
14	6,110	2,470	1,240	294	178	152	29	3,100	.....	1,040	178	152	152
15	8,200	3,200	1,240	234	178	152	30	2,820	.....	1,300	178	152	152
							31	2,920	.....	980	.....	152	.....

NOTE.—These discharges are based on a rating curve that is well defined below 7,700 second-feet.

Monthly discharge of South Fork of Yamhill River at Sheridan, Oreg., for 1909.

[Drainage area, 290 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	17,900	428	4,640	16.0	18.45	285,000	A.
February	12,600	2,470	5,700	19.7	20.51	317,000	A.
March	3,790	980	1,500	5.17	5.96	92,200	A.
April	980	178	334	1.15	1.28	19,900	B.
May	205	152	172	.593	.68	10,600	B.
June	152	127	149	.514	.57	8,870	B.
The period	.....	.....	.....	.....	.....	734,000	

YAMHILL RIVER AT LA FAYETTE, OREG.

This station was established October 6, 1908, for the purpose of developing a rating curve to be applied to old records of gage height obtained at the locks by the United States Weather Bureau and the United States Army engineers. It is located at the county highway bridge at La Fayette, Oreg., three-fourths of a mile above the locks and about 1½ miles below the junction of the North and South forks.

The vertical staff gage is in two sections attached to the north abutment of the highway bridge from which discharge measurements are made.

The data will be particularly valuable for determining the run-off from areas draining the eastern slope of the Coast Range. The run-off on this range is exceedingly high and the river is subject to excessive floods. They will also complete the study of general run-off conditions in the Willamette Valley.

No discharge measurements were made during 1909, and the data obtained are insufficient for a determination of discharge.

Daily gage height, in feet, of Yamhill River at La Fayette, Oreg., for 1909.

[H. W. Koch, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.5	6.7	6.8	4.2	2.7	2.5	1.8	1.55	1.2	1.4	3.0	13.2
2	6.5	8.8	6.9	4.1	2.5	2.2	1.8	1.55	1.2	1.35	3.8	11.2
3	8.5	9.8	7.0	3.7	2.4	2.3	1.8	1.5	1.3	1.35	7.3	7.8
4	8.3	9.1	6.8	3.4	2.5	2.1	1.7	1.5	1.25	1.1	6.8	7.0
5	7.7	8.5	6.5	3.3	2.6	2.2	1.7	1.5	1.2	1.2	5.35	5.9
6	6.9	8.6	5.8	3.1	2.5	2.2	1.9	1.5	1.25	1.2	4.3	4.7
7	6.5	8.6	5.6	2.8	2.5	2.3	2.0	1.5	.9	1.6	3.75	4.9
8	5.9	8.0	5.2	2.7	2.5	2.3	2.1	1.45	.7	1.65	6.1	5.1
9	5.6	7.5	5.8	2.7	2.4	2.3	1.9	1.45	.5	.9	7.1	7.9
10	5.4	7.1	5.9	2.6	2.3	2.3	1.8	1.4	.4	1.4	7.2	10.0
11	3.9	7.2	5.0	3.0	2.7	2.3	1.8	1.5	.3	1.4	7.5	12.0
12	3.3	6.5	4.6	3.2	2.7	2.1	1.8	1.5	.45	1.45	6.8	16.1
13	3.3	7.1	4.3	3.2	2.7	2.1	1.9	1.5	.45	1.45	6.0	18.4
14	3.0	6.9	4.0	3.2	2.5	2.1	1.9	1.5	.45	1.45	4.8	17.8
15	4.5	7.1	4.0	3.1	2.4	2.0	1.8	1.5	.3	1.45	4.2	14.2
16	7.7	8.2	3.7	2.8	2.4	2.0	1.8	1.5	.35	1.4	3.8	8.0
17	11.5	11.2	3.7	2.8	2.4	2.0	1.8	1.45	.3	1.4	3.7	6.5
18	17.5	13.6	3.7	2.9	2.4	2.0	1.8	1.45	1.1	1.4	4.7	5.6
19	21.4	14.8	3.5	2.7	2.3	1.9	1.7	1.4	1.3	1.4	7.1	5.1
20	27.3	13.5	3.6	2.7	2.1	1.9	1.7	1.35	1.35	1.5	9.5	4.7
21	29.0	11.4	3.9	2.7	1.9	1.9	1.7	1.4	1.25	2.1	11.0	4.3
22	27.5	8.2	3.7	2.7	1.9	1.9	1.7	1.45	1.3	2.8	14.7	4.0
23	25.3	6.8	3.6	2.6	2.2	1.8	1.65	1.4	1.3	2.6	19.9	3.6
24	22.0	6.6	3.4	2.6	2.2	1.8	1.6	1.4	1.25	2.25	25.6	3.3
25	16.0	7.6	3.3	2.5	2.1	1.8	1.6	1.4	1.3	2.0	28.2	3.3
26	8.0	7.5	3.1	2.5	2.1	1.8	1.6	1.4	1.35	1.9	31.3	3.3
27	6.4	7.0	3.1	2.5	1.9	1.8	.9	1.4	1.25	1.85	27.3	3.2
28	5.5	7.3	3.3	2.7	2.1	1.8	.5	1.4	1.35	1.75	18.9	3.0
29	5.5	.....	3.3	2.7	2.3	1.8	.5	1.4	1.3	1.75	11.1	3.0
30	4.8	.....	3.3	2.7	2.5	1.9	1.4	1.1	1.2	1.85	13.4	2.9
31	5.4	.....	3.3	.....	2.5	.....	1.6	1.1	.....	2.15	.....	4.4

NOTE.—No ice at this station. Gage heights at low water are affected by operation of locks.

MOLALLA RIVER BASIN.

MOLALLA RIVER NEAR MOLALLA, OREG.

This station was established November 1, 1905. It is located 3 miles below the mouth of the North Fork of the Molalla on the farm of Raymond Dickey, 3½ miles southeast of Molalla post office, Oreg.

This will probably be one of the first streams to be used for irrigation in the Willamette Valley, and for this reason the data are particularly valuable. The records also furnish a measure of the run-off from streams draining the foothills of the Cascades from which a part of the forest cover has been cut.

Since the establishment of the station the gage datum has not been changed, although the gage has washed out several times. It was replaced as soon as practicable afterwards, but there still remain intervals when the gage heights were estimated and on this account low-water estimates are impossible. The gage heights are affected somewhat by logs during the logging season. No discharge measurements were made during 1909. The conditions at the station require a large number of measurements each season, and on this account it was necessary to discontinue the records on July 12, 1909, until more funds are available.

Daily gage height, in feet, of Molalla River near Molalla, Oreg., for 1909.

[Raymond Dickey, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
1....	3.0	3.0	4.1	4.4	3.0	3.9	1.8	16....	6.8	5.9	3.3	2.7	3.0	2.2	.....
2....	3.3	3.2	4.2	3.9	3.5	3.7	1.7	17....	6.9	6.3	3.4	2.7	3.0	2.3	.....
3....	3.4	3.3	4.2	3.6	3.4	3.6	1.6	18....	6.5	6.7	3.5	2.7	3.0	2.4	.....
4....	4.5	3.4	4.3	3.4	3.3	3.3	1.6	19....	9.5	5.6	3.3	2.6	3.0	2.3	.....
5....	4.1	3.5	4.5	3.3	3.2	3.1	1.4	20....	8.6	4.9	3.1	2.6	2.9	2.3	.....
6....	3.8	3.4	4.5	3.2	3.0	3.0	3.45	21....	8.4	4.5	3.0	2.5	2.8	2.2	.....
7....	4.3	3.3	4.3	3.1	2.9	2.9	3.1	22....	6.5	4.0	3.0	2.6	2.7	2.1	.....
8....	3.8	3.3	4.1	3.1	2.8	2.7	2.8	23....	5.2	3.8	3.1	2.6	2.6	2.1	.....
9....	3.5	3.2	3.8	3.0	2.8	2.5	2.7	24....	4.5	4.1	3.1	2.7	2.5	2.0	.....
10....	3.1	3.3	3.5	2.9	2.9	2.4	2.6	25....	4.2	3.7	3.0	2.8	2.6	2.0	.....
11....	2.8	3.3	3.4	2.9	2.9	2.5	2.6	26....	4.0	3.9	3.0	2.8	3.0	1.9	.....
12....	2.5	3.4	3.3	2.8	3.0	2.5	2.5	27....	3.8	4.1	2.9	4.2	3.4	1.9	.....
13....	2.4	3.5	3.2	2.8	3.0	2.4	.....	28....	3.5	4.2	2.9	3.8	3.7	1.9	.....
14....	2.6	3.4	3.1	2.8	2.9	2.3	.....	29....	3.3	.....	2.8	3.6	3.8	1.8	.....
15....	5.9	3.8	3.2	2.8	3.0	2.3	.....	30....	3.1	.....	3.2	3.5	4.2	1.8	.....
								31....	3.0	.....	3.5	.....	4.1	.....	.....

CLACKAMAS RIVER DRAINAGE BASIN.

CLACKAMAS RIVER NEAR CAZADERO, OREG.

This station was established January 1, 1909, by the Portland Railway, Light & Power Co., with which the Geological Survey cooperates in its maintenance. The station is located 2 miles above the dam of the Portland Railway, Light & Power Co., at Cazadero, Oreg., and is above all backwater influence from that dam.

The gage is a vertical staff graduated to feet and tenths, and reads sea-level elevations (Portland Railway, Light & Power Co. datum). It is about 50 feet above the cable. Measurements are made from a standard cable and car equipment. The gaging section is located in a comparatively quiet pool just above a riffle and below a rather narrow box canyon. Conditions are not favorable for discharge measurements at high water, but are favorable for good results at medium and low stages. Both banks of the stream are high and rocky. The bed is composed of gravel and cobblestones.

The station is at the second dam site of the Clackamas River development by Portland Railway, Light & Power Co., where it is proposed to erect a dam for the development of water power to be operated in conjunction with the plant at Cazadero. The data obtained are therefore of value in this connection, and furnish reliable data for comparative purposes elsewhere.

A gage is also maintained at the company's dam 2 miles downstream where daily gage readings are obtained. The dam as first constructed had a triangular crest, downstream slope 2½:1 and upstream slope 6:1. In 1909 it was reconstructed. It is now of ogee cross section, constructed of timber with an upstream slope of 2½:1. The crest is at an elevation of 521.25 feet and is 170 feet in length and about 40 feet above the apron. The abutments of the dam extend upstream 53 feet from the crest. In the left abutment are located the gates for diverting water into the power canal, and the gage is located at the extreme left end of the left abutment, and hence is 53 feet upstream from the crest of the dam. It is graduated in feet and tenths, and reads from sea level (Portland Railway, Light & Power Co. datum).

Discharge measurements of Clackamas River near Cazadero, Oreg., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Feet.*	*Sec.-ft.*
Mar. 17	H. D. McGlashan	113	1,260	27.75	3,180
Aug. 24	S. C. Hulse	144	483	25.77	992
26	J. C. Stevens	148	485	25.81	982
Sept. 29	S. C. Hulse	144	528	25.95	1,200
Oct. 6	do	144	499	25.88	1,040
6	do	144	498	25.88	1,120
13	do	144	475	25.71	936
20	do	144	580	26.50	1,620
29	do	143	541	26.20	1,330
29	do	144	544	26.20	1,430
Nov. 3	do	183	1,640	32.80	13,690
12	do	149	712	27.40	2,550
13	do	165	1,180	30.22	7,680
Dec. 17	do	156	1,100	28.90	3,610
24	do	151	940	27.72	2,390

Daily gage height, in feet, of Clackamas River near Cazadero, Oreg., for 1909.

[J. A. Brooks, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	27.02	27.42	28.15	28.58	27.91	28.95	26.33	26.00	25.73	25.96	27.40	31.15
2	26.98	27.39	28.78	28.35	28.10	28.84	26.30	25.98	25.72	25.84	30.90	30.28
3	26.96	27.56	28.58	28.10	28.50	28.51	26.28	25.95	25.71	25.80	29.98	29.68
4	28.70	27.50	28.40	27.98	28.88	28.86	26.24	25.92	25.70	25.74	28.92	29.18
5	28.25	27.50	28.12	27.88	28.42	28.07	26.27	25.90	25.69	25.72	28.30	28.91
6	27.75	27.39	27.88	27.70	28.15	27.85	26.78	25.89	25.68	25.86	27.80	28.56
7	28.60	27.30	27.69	27.55	27.90	27.72	26.79	25.88	25.68	25.90	27.44	28.40
8	28.65	27.15	27.70	27.49	27.85	27.56	26.48	25.85	25.67	25.81	27.69	28.31
9	27.85	27.15	27.62	27.52	27.85	27.52	26.38	25.85	25.67	25.79	27.90	28.64
10	26.95	27.11	27.48	27.59	27.82	27.51	26.35	25.83	25.70	25.75	27.95	28.36
11	28.55	27.04	27.38	27.50	27.86	27.52	26.39	25.82	25.78	25.74	27.82	28.91
12	30.25	27.02	27.32	27.50	27.85	27.44	26.35	25.80	25.77	25.73	27.43	31.92
13	28.75	27.05	27.30	27.46	27.70	27.26	26.30	25.80	25.72	25.72	27.31	31.90
14	27.15	27.08	27.30	27.50	27.62	27.18	26.24	25.80	25.70	25.70	27.05	30.60
15	28.95	27.58	27.38	27.53	27.58	27.14	26.19	25.80	25.69	25.69	26.82	29.80
16	31.50	28.85	27.55	27.53	27.58	27.16	26.16	25.80	25.68	25.68	26.68	29.34
17	30.70	31.20	27.75	27.51	27.62	27.10	26.16	25.79	25.68	25.67	26.72	28.89
18	32.00	30.55	27.66	27.50	27.52	27.00	26.15	25.79	25.68	25.66	29.34	28.62
19	34.75	29.95	27.56	27.42	27.52	26.89	26.12	25.78	25.67	25.75	32.85	28.39
20	36.15	29.15	27.48	27.40	27.48	26.84	26.04	25.76	25.86	26.42	34.70	28.22
21	34.10	28.60	27.38	27.30	27.42	26.76	26.01	25.76	26.09	26.46	30.72	28.02
22	31.95	28.22	27.26	27.29	27.35	26.71	26.00	25.76	25.88	26.28	41.00	27.88
23	30.45	27.98	27.21	27.28	27.29	26.64	25.79	25.75	25.76	26.08	38.25	27.78
24	29.50	28.35	27.19	27.22	27.26	26.60	25.58	25.75	25.73	25.98	38.90	27.68
25	28.88	28.45	27.22	27.30	27.36	26.54	26.00	25.75	25.72	25.92	33.40	27.60
26	28.42	28.20	27.25	27.72	27.60	26.52	26.12	25.78	25.72	25.84	31.65	27.55
27	28.12	28.10	27.42	28.98	28.15	26.52	26.25	25.79	25.72	25.82	30.65	27.48
28	27.90	28.10	27.53	29.00	28.14	26.46	26.19	25.77	25.72	25.81	31.50	27.41
29	27.68	.....	27.65	28.41	28.15	26.40	26.14	25.74	25.91	26.19	31.09	27.34
30	27.55	.....	27.60	28.10	28.41	26.36	26.06	25.74	26.00	26.10	32.55	27.36
31	27.48	.....	27.84	.....	28.76	.....	26.01	25.74	.....	26.28	.....	28.02

NOTE.—Add 509 feet for sea-level datum.

Daily discharge, in second-feet, of Clackamas River near Cazadero, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,200	2,710	3,780	4,510	3,420	5,140	1,480	1,180	950	1,150	2,680	8,000
2	2,160	2,670	4,850	4,120	3,700	4,950	1,450	1,160	942	1,040	8,990	6,260
3	2,140	2,890	4,510	3,700	4,370	4,390	1,430	1,140	934	1,010	7,100	5,180
4	4,710	2,810	4,200	3,520	5,020	4,980	1,400	1,110	925	959	5,080	4,370
5	3,940	2,810	3,730	3,370	4,230	3,660	1,420	1,100	917	942	4,030	3,960
6	3,180	2,670	3,370	3,100	3,780	3,320	1,940	1,090	908	1,060	3,250	3,460
7	4,540	2,560	3,080	2,880	3,400	3,130	1,950	1,080	908	1,100	2,730	3,240
8	4,620	2,360	3,100	2,800	3,320	2,890	1,620	1,050	900	1,020	3,080	3,120
9	3,320	2,360	2,980	2,840	3,320	2,840	1,520	1,050	900	1,000	3,400	3,580
10	2,120	2,310	2,780	2,940	3,280	2,820	1,500	1,040	925	968	3,480	3,190
11	4,460	2,230	2,650	2,810	3,340	2,840	1,530	1,030	993	959	3,280	3,960
12	7,640	2,200	2,580	2,810	3,320	2,730	1,500	1,010	984	950	2,720	9,570
13	4,800	2,240	2,550	2,760	3,100	2,500	1,450	1,010	942	942	2,560	9,530
14	2,360	2,280	2,550	2,810	2,980	2,400	1,400	1,010	925	925	2,240	6,900
15	5,140	2,930	2,650	2,850	2,920	2,350	1,350	1,010	917	917	1,980	5,380
16	10,400	4,960	2,880	2,850	2,920	2,370	1,320	1,010	908	908	1,830	4,610
17	8,570	9,650	3,180	2,820	2,980	2,300	1,320	1,000	908	900	1,870	3,930
18	11,600	8,260	3,040	2,810	2,840	2,180	1,320	1,000	908	892	5,840	3,550
19	18,600	7,040	2,890	2,710	2,840	2,060	1,290	993	900	968	13,700	3,230
20	22,700	5,490	2,780	2,680	2,780	2,000	1,220	976	1,060	1,560	18,500	3,010
21	16,900	4,590	2,650	2,550	2,710	1,920	1,190	976	1,260	1,600	8,610	2,750
22	11,400	3,890	2,500	2,540	2,620	1,860	1,180	976	1,080	1,430	37,600	2,580
23	8,040	3,520	2,430	2,520	2,540	1,780	1,000	968	976	1,250	29,000	2,460
24	6,140	4,120	2,410	2,450	2,500	1,740	825	968	950	1,160	31,000	2,340
25	5,020	4,280	2,450	2,550	2,630	1,680	1,180	968	942	1,110	13,100	2,240
26	4,230	3,860	2,480	3,130	2,950	1,660	1,290	993	942	1,040	9,000	2,180
27	3,730	3,700	2,710	5,190	3,780	1,660	1,400	1,000	942	1,030	7,000	2,100
28	3,400	3,700	2,850	5,220	3,760	1,600	1,350	984	942	1,020	8,700	2,010
29	3,070	.....	3,020	4,220	3,780	1,540	1,310	959	1,100	1,350	7,880	1,930
30	2,880	.....	2,950	3,700	4,220	1,500	1,230	959	1,180	1,270	11,000	1,950
31	2,780	.....	3,310	.....	4,810	.....	1,190	959	.....	1,430	.....	2,750

NOTE.—These discharges are based on rating curves applicable as follows: Jan. 1 to Nov. 24, well defined between 900 and 14,000 second-feet; Nov. 25 to Dec. 31, well defined between 2,300 and 12,000 second-feet.

Monthly discharge of Clackamas River near Cazadero, Oreg., for 1909.

[Drainage area, 685 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	22,700	2,120	6,350	9.27	10.69	390,000	A.
February	9,650	2,200	3,750	5.47	5.7	208,000	A.
March	4,850	2,410	3,030	4.42	5.1	186,000	A.
April	5,220	2,450	3,190	4.66	5.20	190,000	A.
May	5,020	2,500	3,360	4.91	5.66	207,000	A.
June	5,140	1,500	2,630	3.84	4.28	156,000	A.
July	1,950	825	1,370	2.0	2.31	84,200	A.
August	1,180	959	1,020	1.49	1.72	62,700	A.
September	1,260	900	966	1.41	1.57	57,500	A.
October	1,600	892	1,090	1.59	1.83	67,000	A.
November	37,600	1,830	8,710	12.7	14.17	518,000	B.
December	9,570	1,930	3,980	5.81	6.7	245,000	B.
The year	37,600	825	3,290	4.80	64.93	2,370,000	

EVAPORATION STATION NEAR CAZADERO, OREG.

This station was established May 1, 1909. The evaporation pan is located in the forebay of the power plant of the Portland Railway, Light & Power Co., at Cazadero, Oreg. The pan is of standard type, 3 feet square and 18 inches deep, with a needle point in the center to which the water surface can be adjusted at the time of observation. The observer is supplied with a cup, the contents of which will raise the water 0.1 inch. The elevation of the water surface in the forebay is about 520 feet above mean sea level. The station is maintained in cooperation with the Portland Railway, Light & Power Co.

Evaporation from water surface at Cazadero, Oreg., 1909.

Months.	Evaporation.	Precipitation.
	Inches.	*Inches.*
May	1.63	3.38
June	1.50	.22
July	1.66	2.53
August	1.69	1.03
September	.86	1.22
October	.58	2.44
November	.46	19.69
December	.43	4.62
The period	8.81	35.13

CLACKAMAS RIVER AT ESTACADA, OREG.

This station was established April 6, 1908, and replaces the station formerly maintained at Barton, Oreg. It is located on the Oregon Water Power Co.'s park at Estacada, Oreg., about 1¾ miles downstream from the Portland Railway, Light & Power Co.'s hydroelectric plant at Cazadero. The river at this point flows in a deep canyon, and it was impossible to find a site which combined proper

gaging facilities with easy accessibility. It was therefore necessary to install two gages. The upper gage—No. 1—on which daily readings are made, is located at the foot of a stairway leading to the water's edge opposite the dance hall in the park. The cable from which measurements are made is located about one-fourth mile downstream from this point, where gage No. 2 was installed. All measurements have been referred to both gages. Between the two gages there is a small amount of inflow from springs, the larger being from the left bank just above the gaging site. The flow of these springs, however, is hardly over 1 per cent of the flow of the stream at extreme low water.

The nonuniform use of the water at the power plant causes daily fluctuations in the quantity of water passing the gaging station. This fluctuation is very noticeable at low water, but becomes relatively less at higher stages. On account of these artificial variations in flow it was necessary to establish a station out of influence of the power plant. Accordingly this station, 2 miles above Cazadero, was established January 1, 1909. The discharge at the two points should be virtually the same as there are no intervening tributaries.

For purposes of comparison, however, the discharges for 1909 at this station are given.

Discharge measurements of Clackamas River at Estacada, Oreg., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.		Discharge.
				No. 2.	No. 1.	
1908.		*Feet.*	*Sq. ft.*	*Feet.*	*Feet.*	*Sec.-ft.*
Apr. 6	J. C. Stevens	164	920	2.3	5.58	2,890
July 13	H. D. McGlashan	148	761	1.2	4.22	1,410
Aug. 15	L. R. Allen	143	667	.84	3.84	1,030
Sept. 26	Stevens and Post	144	642	.62	3.60	877
Dec. 30[a]	J. C. Stevens	158	943	2.52	5.97	2,920
1909.						
Jan. 3	Stevens and Kimble	155	931	2.0	5.43	2,520
18	J. C. Stevens	187	1,640	6.4	10.45	11,300
18	do	188	1,700	6.73	11.00	13,600
20	Howard Kimble	207	2,180	8.5	14.10	19,900
July 20	Stevens and Hoyt	140	710	1.03	4.10	1,170

[a] This measurement was not published in Water-Supply Paper 252 as there was reason to doubt its reliability. Later measurements confirm it, however.

Daily gage height, in feet, of Clackamas River at Estacada, Oreg., for 1909.

[N. L. S. Laurry, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	5.4	5.7	6.6	7.0	6.2	7.4	4.38	4.2	3.7	4.2	5.9	8.75
2	5.52	5.7	7.25	6.7	6.35	7.25	4.48	4.15	4.0	4.05	10.0	8.05
3	5.52	6.0	7.05	6 5	6.85	7.1	4.5	4.0	4.05	4.05	8.9	7.35
4	6.4	5.8	6.85	6.18	7.35	6.65	4.45	4.1	3.75	4.05	7.55	6.85
5	6.78	5.85	6.52	6.15	6.82	6.4	4.28	4.1	3.55	4.05	6.8	6.7
6	6.3	5.9	6.25	5.92	6.42	6.15	5.05	4.15	3.5	3.9	6.3	6.65
7	6.05	5.5	6.0	5.7	6.15	5.95	5.05	4.2	3.6	3.85	5.95	6.35
8	5.85	5.75	6.0	5.75	6.05	5.9	4.55	4.25	3.65	3.95	6.4	6.35
9	5.6	5.5	6.0	5.85	6.0	5.8	4.7	3.95	3.9	3.95	6.4	6.4
10	5.25	5.32	5.88	5.9	6.0	5.85	4.5	4.05	4.2	3.8	6.45	6.2

Daily gage height, in feet, of Clackamas River at Estacada, Oreg., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
11	5.3	5.35	5.72	5.82	6.28	5.8	4.25	4.15	4.0	4.0	6.3	6.6
12	5.25	5.32	5.6	5.9	6.15	5.75	4.3	4.2	3.95	3.95	6.1	8.75
13	5.4	5.38	5.62	5.8	6.0	5.48	4.45	3.95	4.0	3.75	5.7	10.0
14	5.6	5.1	5.4	5.9	6.0	5.35	4.4	4.0	3.95	3.8	5.2	8.4
15	7.25	6.05	5.65	5.9	5.95	5.35	4.3	3.95	3.72	3.75	5.05	7.5
16	10.2	8.0	5.8	5.8	5.9	5.35	4.3	4.0	4.0	3.95	5.25	7.1
17	9.35	9.85	6.06	5.9	6.0	5.3	4.25	4.0	3.95	3.95	5.3	6.7
18	11.45	9.25	6.0	5.7	5.85	5.25	4.25	3.9	4.2	4.05	8.15	6.2
19	13.5	8.45	5.7	5.6	5.85	5.2	4.1	3.95	3.55	4.25	11.5	6.1
20	15.05	7.65	5.8	5.5	5.95	5.05	4.1	4.05	3.75	4.6	13.75	6.05
21	13.26	6.9	5.5	5.52	5.8	5.05	4.0	3.95	4.3	4.65	9.35	6.25
22	10.6	6.5	5.65	5.58	5.7	4.82	4.25	3.9	4.35	4.55	18.95	6.0
23	9.0	6.25	5.5	5.45	5.75	4.9	4.15	3.7	4.05	4.45	16.1	5.95
24	7.85	6.75	5.5	5.55	5.8	4.7	4.2	3.8	3.95	4.1	17.1	5.5
25	7.35	6.85	5.45	5.55	5.75	4.75	4.15	3.95	3.95	4.15	11.2	5.55
26	6.88	6.65	5.6	6.1	5.95	4.75	4.45	3.85	3.65	4.25	8.9	5.45
27	6.52	6.5	5.75	7.45	6.45	4.5	4.4	4.05	3.7	4.15	8.05	5.45
28	6.2	6.35	5.65	7.5	6.45	4.55	4.25	3.95	4.1	4.25	8.35	5.35
29	6.05	.....	6.05	6.75	6.5	4.55	4.05	3.8	4.2	4.55	8.7	5.45
30	5.95	.....	5.95	6.52	6.75	4.58	4.25	3.85	4.25	4.4	10.95	5.75
31	5.7	.....	6.0	.....	7.05	.....	4.15	3.95	.....	4.8	.....	5.85

NOTE.—Readings are at gage No. 1. Staff gage.

Daily discharge, in second-feet, of Clackamas River at Estacada, Oreg., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	2,390	2,720	3,950	4,600	3,360	5,280	1,410	1,260	910	1,260	2,970	7,760
2	2,520	2,720	5,020	4,100	3,580	5,020	1,490	1,220	1,110	1,150	10,300	6,430
3	2,520	3,100	4,680	3,800	4,350	4,770	1,510	1,110	1,150	1,150	8,050	5,200
4	3,650	2,840	4,350	3,340	5,200	4,030	1,470	1,180	943	1,150	5,540	4,350
5	4,230	2,910	3,830	3,300	4,300	3,650	1,320	1,180	814	1,150	4,260	4,100
6	3,500	2,970	3,440	3,000	3,680	3,300	2,030	1,220	782	1,040	3,500	4,030
7	3,160	2,500	3,100	2,720	3,300	3,040	2,030	1,260	846	1,010	3,040	3,580
8	2,910	2,780	3,100	2,780	3,160	2,970	1,560	1,300	878	1,080	3,650	3,580
9	2,610	2,500	3,100	2,910	3,100	2,840	1,690	1,080	1,040	1,080	3,650	3,650
10	2,230	2,310	2,940	2,970	3,100	2,910	1,510	1,150	1,260	976	3,720	3,360
11	2,290	2,340	2,750	2,870	3,480	2,840	1,300	1,220	1,110	1,110	3,500	3,950
12	2,230	2,310	2,610	2,970	3,300	2,780	1,340	1,260	1,080	1,080	3,230	7,760
13	2,390	2,370	2,630	2,840	3,100	2,480	1,470	1,080	1,110	943	2,720	10,300
14	2,610	2,080	2,390	2,970	3,100	2,340	1,420	1,110	1,080	976	2,180	7,080
15	5,020	3,160	2,670	2,970	3,040	2,340	1,340	1,080	910	943	2,030	5,460
16	10,700	6,340	2,840	2,840	2,970	2,340	1,340	1,110	1,110	1,080	2,230	4,770
17	8,950	9,980	3,180	2,970	3,100	2,290	1,300	1,110	1,080	1,080	2,290	4,100
18	13,500	8,750	3,100	2,720	2,910	2,230	1,300	1,040	1,260	1,150	6,620	3,300
19	18,400	7,180	2,720	2,610	2,910	2,180	1,180	1,080	814	1,300	13,600	3,230
20	22,400	5,720	2,840	2,500	3,040	2,030	1,180	1,150	943	1,600	19,100	3,160
21	17,800	4,430	2,500	2,520	2,840	2,030	1,110	1,080	1,340	1,650	8,950	3,440
22	11,600	3,800	2,670	2,590	2,720	1,810	1,300	1,040	1,380	1,560	33,000	3,100
23	8,250	3,440	2,500	2,450	2,780	1,880	1,220	910	1,150	1,470	25,200	3,040
24	6,070	4,180	2,500	2,560	2,840	1,690	1,260	980	1,080	1,180	27,900	2,500
25	5,200	4,350	2,450	2,560	2,780	1,740	1,220	1,080	1,080	1,220	13,000	2,560
26	4,400	4,030	2,610	3,230	3,040	1,740	1,470	1,010	878	1,300	8,050	2,450
27	3,830	3,800	2,780	5,370	3,720	1,510	1,420	1,150	910	1,220	6,430	2,450
28	3,360	3,580	2,670	5,460	3,720	1,560	1,300	1,080	1,180	1,300	6,990	2,340
29	3,160	.....	3,160	4,180	3,800	1,560	1,150	976	1,260	1,560	7,660	2,450
30	3,040	.....	3,040	3,830	4,180	1,580	1,300	1,010	1,300	1,420	12,400	2,780
31	2,720	.....	3,100	.....	4,680	.....	1,220	1,080	.....	1,790	.....	2,910

NOTE.—These discharges are based on a rating curve that is well defined between 800 and 19,700 second-feet. The daily flow is affected by the power plant above.

Monthly discharge of Clackamas River at Estacada, Oreg., for 1909.

[Drainage area, 668 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	22,400	2,230	6,050	8.79	10.13	372,000	B.
February	9,980	2,080	3,900	5.67	5.9	217,000	A.
March	5,020	2,390	3,070	4.46	5.14	189,000	A.
April	5,460	2,450	3,220	4.68	5.22	192,000	A.
May	4,680	2,720	3,390	4.93	5.68	208,000	A.
June	5,280	1,510	2,630	3.82	4.26	156,000	A.
July	2,030	1,110	1,390	2.02	2.33	85,500	A.
August	1,300	910	1,120	1.63	1.88	68,900	B.
September	1,380	814	1,060	1.54	1.72	63,100	B.
October	1,790	943	1,230	1.79	2.06	75,600	B.
November	33,000	2,030	8,530	12.4	13.83	508,000	B.
December	10,300	2,340	4,170	6.06	6.99	256,000	B.
The year	33,000	814	3,310	4.82	65.14	2,390,000	

LEWIS RIVER DRAINAGE BASIN.

DESCRIPTION.

Lewis River has its source in Adams Glacier, on the northwest slope of Mount Adams, flows in a general southwesterly direction, and empties into Columbia River 19 miles below Vancouver, Wash. Its lower half forms the boundary line between Cowlitz and Clarke counties, Wash.; its upper half is entirely within Skamania County. The total length of the main river is 110 miles, and the stream drops 7,900 feet in that distance.

The principal tributaries in order downstream are, from the north, Muddy River, Pine Creek, Swift Creek, Cougar Creek, and Speilei Creek; from the south, Drift Creek, Siouxon Creek, Canyon Creek, Cedar Creek, and South Fork. Of these South Fork has the largest drainage area, but contributes a relatively small portion of the flow. Muddy River and Pine and Swift creeks supply a large part of the tributary discharge.

The total area drained by Lewis River is 1,070 square miles, distributed as follows:

Area of Lewis River drainage basin.

	Square miles.
Above mouth of Muddy River	250
Above mouth of Swift Creek	474
Below mouth of Cougar Creek	552
At Ariel	728
Above the mouth of South Fork	860
At mouth	1,070
Muddy River	121
Pine Creek	21
Swift Creek	26
Cougar Creek	6
South Fork	195

Mount Adams, 12,307 feet high, and Mount St. Helens, 9,750 feet (height not accurately determined), are the prominent topographic features of this territory. Mount Adams is just to the east of the summit of the Cascade Range and Mount St. Helens is 35 miles almost due west from Mount Adams and 14 miles southwest from the nearest point on the divide. Other peaks are Steamboat Mountain (4,600 feet) and The Castle (5,100 feet), standing southwest of the headwaters. Powderhorn Peak is near the mouth and north of the river.

The area is characterized by rough mountains and by ridges and spurs from the highest peaks. Toward the summit of the range the country becomes more abrupt and rugged. The streams all flow in canyons. In the upper portions the canyon sides are steep and rugged; in the lower stretches there are high benches of fairly level land and valleys of small extent bordering the river.

The rocks are almost entirely of igneous origin and comprise basalts, lavas, and pumice. Some recent lava flows lie around the bases of Mount St. Helens and Mount Adams. The rivers have cut deeply into these formations and in some places ten or more distinct lava flows can be counted. The soil resulting from the disintegration of these rocks is mixed with volcanic ash and is very fertile. Trees and brush grow in profusion, and where valley lands have been cleared good crops can be raised.

About one-fourth of the Lewis River drainage basin lies within the Columbia National Forest. Within this area the average stand of timber is over 13,000 feet b. m. per acre. The entire area is essentially densely forested, and although logging operations have been carried on for years the cut-over area forms a relatively small part of the total. The lands contiguous to the lower portion of the river are the only ones that show the effect of these logging operations, and they are rapidly being restocked except where they have been cleared for agriculture. Red and yellow fir are the predominating species and constitute about 50 per cent of the total stand. There are also large quantities of hemlock, Noble fir, and cedar. All through the forests the underbrush is very dense. Wherever the continuous shade of the large trees has been broken by logging or on burned areas the undergrowth is most pronounced. Salal, vine maple, huckleberry, dogwood, syringa, snowberry, wild rose, blackberry, and salmonberry are prevalent species. These, mingled with young seedlings of the conifers and with ferns, vines, and brambles and the decaying and moss-covered trunks of fallen trees, make an almost impenetrable mass.

The Seattle and Portland line of the Northern Pacific Railway crosses Lewis River near its mouth, and a logging branch line runs from Vancouver to Yacolt, near the headwaters of Cedar Creek. The

main stream is navigable for small boats as far as Ariel except during the low-water season. A river steamer runs regularly between Portland and Woodland, and a small steamboat runs from Woodland to Ariel, or Runyons Landing, as this place was known before the post office was established.

A wagon road follows the north bank of the river from Woodland to Petersons and there is a good trail from Petersons to Pine Creek. There is also a wagon road on the south side of the river from Woodland to Cressup's ferry. The drainage area of South Fork is not so mountainous and is much better improved, there being a goodly number of settlers and roads in all directions.

The percentage of farming land in this area is comparatively small. Where timbered lands have been cleared, however, as along the rolling table-lands and broader valley of South Fork and the lower portions of the main river, good crops can be grown. Farther upstream the valley becomes narrower and the suitable farm land is in small benches or narrow strips in the floor of the canyon. All crops common to a mild and moist climate are grown. Fruits of all kinds are found in abundance. Apples, pears, cherries, and small fruits and berries are grown with excellent results. At present, however, the principal industry is lumbering. There are a number of lumber and shingle mills near the mouth of the river, although most of the logs cut are transported by water to the mills on Columbia River. At many points along the main stream flumes lead from the high mountains to the river bank. These are used for floating shingle bolts from the hills into the river.

So far as known there are no favorable sites where a large amount of storage could be developed. In the canyon of the main stream there are numerous dam sites where a moderate amount of storage could be developed for the use of a power plant with daily load variations.

Lake Merrill lies on the divide between the headwaters of Cougar Creek and Kalama River. It has no surface outlet, but its waters probably find their way through the lavas that surround it into both these streams. It could doubtless be raised and water could be diverted in either direction, although diversion into Kalama River would be the easier. The formations indicate that the larger portion of the water now flows into Kalama River. The water surface of the lake is less than 1 square mile and the drainage area comprises 6.9 square miles. During the summer of 1909 the United States Geological Survey made a water-power survey of this basin.[1] Discharge measurements were made on all important tributaries and on the main stream at various points to determine the summer flow.

[1] For the results of this investigation, including profiles of the rivers surveyed, see Stevens, J. C., Water powers of the Cascade Range, pt. 1, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

The stream-flow data obtained during this investigation are included in the present report.

So far as could be learned at the time of this survey no records of discharge or gage heights have been kept on any of the streams in this basin. There is a gage at Woodland which is used as a guide for determining the time of running boats, and another one was found at Ariel, but no systematic records of river heights have been kept from either of them.

Lewis River has a fairly well maintained flow during the summer season. This flow is largely supplied from the glaciers on Mount Adams and Mount St. Helens. The grade of the main stream, however, is not exceptionally steep until the ascent of the main range is begun. From Ariel to the falls, 14 miles above the mouth of Muddy River, the stream falls 1,495 feet in 51.4 miles, an average of 29 feet to the mile. In the upper 14 miles of this distance the average fall is 39.5 feet to the mile; in the last 7 miles the average fall is only 11.3 feet to the mile. Muddy River was surveyed for 9 miles above its mouth, and an average fall of 44.4 feet to the mile was found. Pine Creek drops 233 feet in the last 1.6 miles, an average of 146 feet to the mile. Swift Creek has an average fall at its mouth of 172 feet to the mile, and Cougar Creek 125 feet to the mile.

Many favorable sites for dams are found along the main stream and tributaries. These occur where the canyons narrow to chasms with vertical jagged walls of solid rock. In many places bedrock is exposed in the bed of the stream or is lightly covered with gravel and bowlders. Along the canyon sides there are many benches upon which open canal construction would be possible. The more feasible sites are along the upper portions of the river, and it is likely that opportunities for high-head developments will be found beyond the limits of the survey. This portion of the river, however, is best reached from the east side of the range—that is, by way of White Salmon River, Trout Creek, and the Indian Race Tracks. There are no trails along Lewis River above Muddy River. The river canyon is almost impassable in this portion, and no further progress could have been made without adding an unwarranted amount to the expense of the investigation.

Being glacier fed, the river is heavily loaded with glacial silt near the headwaters. This silt, however, gradually settles out, and in the lower reaches the water is comparatively clear. Muddy River, the most pronounced glacial tributary, is supplied from the glaciers on Mount St. Helens. Pine Creek is not a glacial stream, the water being largely supplied from ground storage in the lava beds through which it flows. Swift Creek, on the other hand, is glacial, and the waters are white with silt during warm weather.

LEWIS RIVER ABOVE MUDDY RIVER, NEAR COUGAR, WASH.

This station, which is located 1½ miles above the mouth of Muddy River, 18 miles above Peterson's ranch and 23 miles above Cougar post office, was established August 8, 1909, to obtain data concerning low-water flow.

The gage is a vertical staff fastened to a vertical face of rock on the right bank. Measurements were made by wading, and no facilities have been provided for making measurements at high stages. On account of the isolation it was not possible to secure daily observations.

Discharge measurements of Lewis River above Muddy River, near Cougar, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
Aug. 8	C. W. Harris	147	247	1.72	1.06	[a] 427
13	do	88	164	2.62	1.04	[b] 430

[a] Made by wading opposite gage. [b] Made by wading 2 miles above gage.

Daily gage height, in feet, of Lewis River above Muddy River, near Cougar, Wash., for 1909.

[Ole Peterson, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22	1.0		
3				13	1.04			23			
4		0.92		14				24			
5				15			0.80	25			
6				16				26			
7				17				27			
8	1.05			18				28	.95		
9				19			.90	29			
10				20				30			
								31			

Daily discharge, in second-feet, of Lewis River above Muddy River, near Cougar, Wash., for 1909.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	500	295	240	11	440	200	160	21	350	350	500
2	500	295	200	12	425	200	160	22	350	240	350
3	440	262	160	13	410	200	160	23	295	240	425
4	440	262	200	14	410	200	160	24	295	200	350
5	440	295	240	15	425	200	160	25	295	200	240
6	440	240	295	16	410	160	160	26	295	160	240
7	440	240	295	17	350	160	160	27	295	160	200
8	440	240	240	18	350	160	240	28	295	160	295
9	425	240	240	19	350	295	240	29	295	160	425
10	440	200	200	20	350	350	350	30	295	200	425
								31	295		595

NOTE.—These discharges are based on a rating curve that is not well defined.

Monthly discharge of Lewis River above Muddy River, near Cougar, Wash., for 1909.

[Drainage area, 250 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	500	295	380	1.52	1.75	23,400	B.
September	350	160	225	.9	1.0	13,400	B.
October	595	160	265	1.06	1.22	16,300	B.
The period	500	160	290	1.16	3.97	53,100	

LEWIS RIVER AT PETERSON'S RANCH, NEAR COUGAR, WASH.

This station was established July 27, 1909. It is located 1,000 feet above the mouth of Swift Creek, at the first riffle below a large outcrop of rock on the right bank, 2 miles above Peterson's ranch and 7 miles above Cougar post office, Wash. The gage is a vertical staff graduated to feet and tenths in two sections, the first 12 feet being attached to a point of the rock above mentioned. Measurements are made by use of a meter running on a small cable and operated from the bank. The river is crossed by means of a raft.

This station is intended as a permanent one, although facilities for making measurements at high stages have not yet been installed. It is maintained in cooperation with H. L. Gilbert, of Portland, Oreg.

Discharge measurements of Lewis River at Peterson's ranch, near Cougar, Wash., for 1909.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 27	C. W. Harris	125	333	3.75	3.45	1,250
Aug. 19 [a]	do	108	254	3.06	2.95	776

[a] Made 12 feet above first measurement.

Daily gage height, in feet, of Lewis River at Peterson's ranch, near Cougar, Wash., for 1909.

[Ole Peterson, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Day.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	3.32	2.73	2.75	3.75	9.6	16	.....	2.95	2.62	2.55	4.3	4.9
2	.....	3.28	2.73	2.7	8.2	7.1	17	.....	2.95	2.6	2.52	4.5	4.8
3	.....	3.25	2.8	2.7	9.6	6.2	18	.....	2.95	2.53	2.5	7.5	4.6
4	.....	3.2	2.8	2.65	7.4	6.0	19	.....	2.95	2.6	2.8	11.4	4.4
5	.....	3.15	2.8	2.65	6.3	5.6	20	.....	2.95	2.95	3.3	9.5	4.3
6	.....	3.1	2.75	2.82	6.3	5.1	21	.....	2.95	2.83	3.5	8.4	4.2
7	.....	3.1	2.7	2.8	5.3	4.1	22	.....	2.95	2.72	3.1	14.6	4.0
8	.....	3.05	2.7	2.7	5.9	4.7	23	.....	2.85	2.7	3.15	14.1	3.95
9	.....	3.03	2.63	2.65	5.9	4.5	24	.....	2.8	2.65	3.0	12.0	3.9
10	.....	3.05	2.63	2.62	5.95	4.5	25	.....	2.82	2.62	2.9	8.9	3.85
11	.....	3.02	2.65	2.6	5.7	4.6	26	.....	2.75	2.62	2.9	7.2	3.8
12	.....	3.0	2.62	2.53	5.3	6.1	27	3.5	2.75	2.6	2.85	6.8	3.7
13	.....	2.95	2.62	2.6	5.0	5.8	28	3.45	2.75	2.6	2.9	7.0	3.7
14	.....	2.92	2.6	2.52	4.7	5.6	29	3.42	2.75	2.63	3.1	12.75	3.7
15	.....	3.0	2.6	2.55	4.5	5.2	30	3.4	2.75	2.65	3.05	11.4	3.75
							31	3.45	2.8	.....	3.4	.....	3.8

Daily discharge, in second-feet, of Lewis River at Peterson's ranch, near Cougar, Wash., for 1909.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	.....	1,110	633	645	16	.....	778	571	535
2	.....	1,070	633	615	17	.....	778	560	520
3	.....	1,040	675	615	18	.....	778	525	510
4	.....	990	675	588	19	.....	778	560	575
5	.....	945	675	588	20	.....	778	778	1,090
6	.....	900	645	688	21	.....	778	694	1,320
7	.....	900	615	675	22	.....	778	627	900
8	.....	858	615	615	23	.....	708	615	945
9	.....	840	576	588	24	.....	675	588	815
10	.....	858	576	571	25	.....	688	571	740
11	.....	832	588	560	26	.....	645	571	740
12	.....	815	571	525	27	1,320	645	560	708
13	.....	778	571	560	28	1,255	645	560	740
14	.....	755	560	520	29	1,220	645	576	900
15	.....	815	560	535	30	1,200	645	588	858
					31	1,255	675	.....	1,200

NOTE.—These discharges are based on a rating curve that is not well defined.

Monthly discharge of Lewis River at Peterson's ranch, near Cougar, Wash., for 1909.

[Drainage area, 474 square miles.]

Month	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	1,110	645	804	1.7	1.96	49,400	A.
September	778	560	604	1.28	1.43	35,900	A.
October	1,320	510	712	1.5	1.73	43,800	A.

LEWIS RIVER AT ARIEL, WASH.

This station was established July 7, 1909. It is located opposite Ariel post office, Wash., one-fourth mile above the mouth of George Creek. It was intended as a temporary station only, and no facilities were installed for making measurements at high stages. The gage is a vertical staff fixed to an alder stump on the right bank near the post office and store. Measurements were made either from a boat held in place by a small cable spanning the stream or by wading at a riffle 1,000 feet below the gage. Conditions at the station are not favorable for good results. The stream is used principally for floating logs. These logs lodging on the riffle in the vicinity of the station cause variable backwater conditions for which it is impossible to make correction.

Discharge measurements of Lewis River at Ariel, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
July 8	C. W. Harris	316	1,080	3.15	3.07	3,410
Aug. 23	do	262	708	1.71	1.75	1,210

Daily gage height, in feet, of Lewis River at Ariel, Wash., for 1909.

[C. R. Keiger, observer.]

Day.	July.	Aug.	Sept.	Oct.	Nov	Day.	July.	Aug.	Sept.	Oct.	Nov.
1	.....	2.20	1.60	1.98	3.66	16	2.72	1.87	1.56	1.55	4.04
2	.....	2.15	1.60	1.68	9.65	17	2.60	1.83	1.55	1.51	4.55
3	.....	2.15	1.66	1.60	10.30	18	2.54	1.78	1.54	1.50	5.85
4	.....	2.12	1.66	1.66	7.18	19	2.41	1.76	1.53	1.65	9.75
5	.....	2.10	1.69	1.76	5.55	20	2.32	1.74	1.88	2.23	9.30
6	.....	2.05	1.66	1.68	4.70	21	2.45	1.72	2.06	2.88	8.10
7	3.23	2.02	1.64	1.58	5.30	22	2.45	1.74	1.65	2.85	9.26
8	3.02	2.00	1.65	1.56	5.46	23	2.48	1.72	1.62	2.41	10.85
9	2.92	2.00	1.64	1.52	5.34	24	2.50	1.80	1.52	2.22	8.60
10	2.90	1.96	1.60	1.57	5.68	25	2.70	1.80	1.58	2.18	7.57
11	3.32	1.92	1.61	1.60	5.36	26	2.65	1.80	1.55	2.10	7.50
12	3.22	1.90	1.60	1.60	4.72	27	2.60	1.82	1.56	2.00	6.85
13	2.98	1.90	1.60	1.60	4.36	28	2.42	1.58	1.54	2.12	7.25
14	2.82	1.88	1.60	1.60	4.19	29	2.34	1.68	1.70	2.38	9.25
15	2.78	1.90	1.50	1.57	3.71	30	2.30	1.65	2.06	2.46	10.90
						31	2.25	1.64	.....	2.90	.....

Daily discharge, in second-feet, of Lewis River at Ariel, Wash., for 1909.

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1	.....	1,870	1,050	1,530	16	2,750	1,380	1,010	1,000
2	.....	1,790	1,050	1,150	17	2,540	1,330	1,000	950
3	.....	1,790	1,120	1,050	18	2,440	1,270	980	940
4	.....	1,740	1,120	1,120	19	2,220	1,240	970	1,110
5	.....	1,710	1,160	1,240	20	2,060	1,220	1,390	1,920
6	.....	1,640	1,120	1,150	21	2,280	1,190	1,650	3,030
7	3,690	1,590	1,100	1,030	22	2,280	1,220	1,110	2,980
8	3,290	1,560	1,110	1,010	23	2,340	1,190	1,070	2,220
9	3,110	1,560	1,100	960	24	2,370	1,290	960	1,900
10	3,070	1,500	1,050	1,020	25	2,710	1,290	1,030	1,840
11	3,870	1,450	1,060	1,050	26	2,620	1,290	1,000	1,710
12	3,670	1,420	1,050	1,050	27	2,540	1,320	1,010	1,560
13	3,210	1,420	1,050	1,050	28	2,230	1,030	980	1,740
14	2,930	1,390	1,050	1,050	29	2,100	1,150	1,170	2,170
15	2,850	1,420	1,030	1,020	30	2,030	1,110	1,650	2,300
					31	1,950	1,100	.....	3,070

NOTE.—These discharges are based on a rating curve not well defined.

Monthly discharge of Lewis River at Ariel, Wash., for 1909.

[Drainage area, 728 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	1,870	1,030	1,400	1.52	1.75	86,100	B.
September	1,650	960	1,110	1.92	2.21	66,000	B.
October	3,070	960	1,510	2.07	2.39	92,800	B.

MUDDY RIVER AT MOUTH, NEAR COUGAR, WASH.

This station was established August 6, 1909. The gage is a vertical staff located half a mile above the mouth of the river on the first

riffle below a rocky gorge, 18 miles above Peterson's ranch and 23 miles above Cougar post office, Wash. The station was established for temporary purposes only, to determine the low-water flow for 1909, and no facilities were installed for making measurements at high stages. Measurements were made with a meter suspended from a small cable spanning the stream and operated from the river bank.

The following discharge measurement was made by C. W. Harris:

August 6, 1909: Width, 87 feet; area, 149 square feet; gage height, 0.80 foot; discharge, 317 second-feet.

Gage height, in feet, of Muddy River at mouth, near Cougar, Wash., for 1909.

[Ole Peterson, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22	0.75		
3		0.6		13				23			
4				14	0.7			24			
5				15			0.35	25			
6	0.80			16				26			
7				17				27			
8	.80			18				28			
9	.78			19			.6	29			
10				20				30			
								31			

Daily discharge, in second-feet, of Muddy River at mouth, near Cougar, Wash., for 1909.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	315	220	185	11	290	185	155	21	290	142	400
2	315	220	185	12	265	185	155	22	290	142	370
3	315	220	170	13	265	185	155	23	290	155	370
4	315	242	170	14	265	170	142	24	242	155	370
5	315	242	185	15	265	170	142	25	220	155	342
6	315	220	202	16	265	170	142	26	220	155	315
7	315	202	185	17	265	170	142	27	220	170	290
8	315	202	170	18	265	155	170	28	220	170	290
9	305	185	170	19	265	155	220	29	220	170	342
10	290	185	170	20	290	155	315	30	220	185	315
								31	242		400

NOTE.—These discharges are based on a rating curve not well defined.

Monthly discharge of Muddy River at mouth, near Cougar, Wash., for 1909.

[Drainage area, 121 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	315	220	274	2.26	2.61	16,800	B.
September	242	142	182	1.50	1.67	10,800	B.
October	400	142	236	1.95	2.25	14,500	B.

PINE CREEK AT MOUTH, NEAR COUGAR, WASH.

This station was established August 4, 1909. The gage is a vertical staff on the left bank of the stream at the old camp grounds, about one-fourth mile above the mouth of the stream, near the quarter corner between secs. 23 and 24, T. 7 N., R. 6 E., about 13 miles east from Cougar, Wash.

The station was established to determine low-water conditions during the summer season of 1909, and no permanent equipment was installed for making measurements at high stages. Measurements were made with a meter suspended from a light cable spanning the stream and operated from the bank. On account of remoteness from settlement continuous records of gage heights were not secured.

The following discharge measurement was made by C. W. Harris:

August 4, 1909: Width, 32 feet; area, 53 square feet; gage height, 1.00 foot; discharge, 142 second-feet.

Gage height, in feet, of Pine Creek at mouth, near Cougar, Wash., for 1909.

[Ole Peterson, observer.]

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1				11				21			
2				12				22			
3				13			0.95	23			
4	1.0			14				24			
5				15				25			
6				16	0.97			26			
7				17				27			
8				18				28			
9				19			1.0	29			
10				20				30			
								31			

Daily discharge, in second-feet, of Pine Creek at mouth, near Cougar, Wash., for 1909.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	142	142	142	11	142	136	136	21	138	155	155
2	142	142	142	12	142	136	136	22	138	149	149
3	142	142	142	13	142	136	136	23	138	149	142
4	142	142	142	14	142	136	136	24	138	142	142
5	142	142	142	15	142	136	136	25	138	142	142
6	142	136	136	16	138	136	136	26	138	142	142
7	142	136	136	17	138	136	136	27	138	136	149
8	142	136	136	18	138	136	136	28	138	136	149
9	142	136	136	19	138	142	142	29	138	136	149
10	142	136	136	20	138	149	149	30	138	136	149
								31	138		149

NOTE.—These discharges are based on a rating curve not well defined.

Monthly discharge of Pine Creek at mouth, near Cougar, Wash., for 1909.

[Drainage area, 21 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	142	138	140	6.67	7.69	8,610	B.
September	155	136	140	6.67	7.44	8,330	B.
October	155	136	141	6.71	7.74	8,670	B.

SWIFT CREEK AT MOUTH, NEAR COUGAR, WASH.

This station was established July 27, 1909. It is located 2 miles from Peterson's ranch, about 4½ miles east and 1 mile north of Cougar post office, Wash., one-fourth mile above the mouth of the stream, near the point where the north line of sec. 28, T. 7 N., R. 5 E. crosses Swift Creek. The gage is a vertical staff fixed to the right bank. Measurements are made from a foot log or by wading near the gage. As the station was established only to determine low-water conditions during the summer season of 1909, no equipment was installed for making measurements at high stages.

The following discharge measurement was made by C. W. Harris:

July 27, 1909: Width, 49 feet; area, 78 square feet; gage height, 2.20 feet; discharge, 179 second-feet.

Gage height, in feet, of Swift Creek at mouth, near Cougar, Wash., for 1909.

[Ole Peterson, observer.]

Day.	July.	Aug.	Sept.	Oct.	Day.	July.	Aug.	Sept.	Oct.
1					16		2.1		
2					17				
3			2.1		18				
4			2.1	2.1	19		2.15		2.15
5		2.2	2.1		20				
6			2.1	2.2	21				
7			2.1	2.2	22				
8			2.1	2.15	23				
9					24		2.1		
10				2.1	25				
11					26				2.2
12		2.15		2.05	27	2.2			
13					28	2.2			
14		2.1			29				
15		2.1			30	2.2			
					31				

Daily discharge, in second-feet, of Swift Creek at mouth, near Cougar, Wash., for 1909.

Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.	Day.	Aug.	Sept.	Oct.
1	179	167	167	11	179	167	167	21	173	167	173
2	179	167	167	12	173	167	162	22	173	167	173
3	169	167	167	13	173	167	162	23	167	167	173
4	179	167	167	14	167	167	162	24	167	167	179
5	179	167	173	15	167	167	167	25	167	167	179
6	179	167	179	16	167	167	167	26	167	167	179
7	179	167	179	17	167	167	167	27	167	167	179
8	179	167	173	18	173	167	173	28	167	167	179
9	179	167	167	19	173	167	173	29	167	167	179
10	179	167	167	20	173	167	173	30	167	167	179
								31	167	.....	179

NOTE.—These discharges are based on a rating curve not well defined.

Monthly discharge of Swift Creek at mouth, near Cougar, Wash., for 1909.

[Drainage area, 26 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Mean per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
August	179	167	173	6.65	7.67	10,600	A.
September	167	167	167	6.42	7.16	9,940	A.
October	169	167	172	6.61	7.62	10,600	A.

COWLITZ RIVER DRAINAGE BASIN.

TOUTLE RIVER BASIN.

DESCRIPTION.

Toutle River, the largest tributary of Cowlitz River, has its source in Spirit Lake, on the northwestern slope of Mount St. Helens, flows in a general westerly direction, and empties into Cowlitz River 2 miles above Castle Rock, Wash. The total length of the river from the outlet of Spirit Lake to its junction with Cowlitz River is 54.3 miles, and the total fall in that distance is 3,153 feet.

The principal tributaries, in their order downstream, are Cold Creek, Hoffstadt Creek, and Green River from the north and Alder Creek, South Fork, and Outlet Creek from the south.

The total drainage area is 510 square miles, distributed as follows:

Area of Toutle River drainage basin.

	Square miles.
Spirit Lake outlet	12
Above mouth of Green River	143
Above mouth of South Fork	295
At Tower gaging station	474
Mouth	510
Green River	128
South Fork	134
Outlet Creek	42

The prominent topographic feature of the area is Mount St. Helens. The elevation of this peak has not been accurately determined, but is given as between 9,750 and 10,000 feet. The general topography of the region is bold and rugged, somewhat similar to that of the adjoining basin of Lewis River. The area is probably the dissected and eroded remainder of a broad plateau that was modified by distorting uplifts and more or less covered with lava flows.

The country to the north and east of Mount St. Helens is included in the St. Helens mining district, and here the volcanic rocks are absent. The general formation in the mining district is syenite cut by porphyry dikes striking almost northwest and dipping 60° or 70° W. Northwest of the syenite belt the country rock is mostly quartzite, broken and traversed by a series of almost perpendicular veins, whose general strike is northeast and southwest. Many of the veins of the district are of great width and carry sulphide ores, mostly of copper, iron, and lead. They are true fissure veins and are found along the contact between the porphyry dikes and the country rock.[1]

The lands contiguous to the lower portion of the river are high and rolling but not rugged. Upstream these rolling lands are gradually replaced by narrower valleys and bench lands topped by bold peaks with scarred and eroded sides. The river canyons, however, are not so abrupt as those of the other streams considered in this report, but the sides are of more uniform slope, with here and there a rocky bluff on one bank or the other. The stream flows on a bed of gravel and cobblestones through almost its entire length, with scattered ledges of partly exposed bedrock dipping steeply into the gravel bed of the river. This indicates that the river canyons at one time were deeper but that they have been filled by water-deposited gravel and talus from the canyon sides.

Only a small portion of this area lies within the Columbia National Forest. The west line of T. 5 N. is the western boundary of this forest, but practically all tracts along the river within it are patented lands.

The average stand of timber on the area is probably 10,000 feet b. m. per acre except where it has been logged off. The timber from the easily accessible tracts has been partly removed, but the greater portion of the timber in the basin is still in its virgin state. Most of the logged-off areas are being restocked and all is covered with young growth and underbrush except where the lands have been cleared for agriculture.

The species found are those common to the western slope of the Cascade Range. Red or yellow fir constitutes about 50 per cent of the stand, cedar about 10 per cent, hemlock 5 per cent, and white fir

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5 per cent, with considerable quantities of Noble fir, mountain hemlock, and Englemann spruce. The rivers are lined with dogwood, alders, and maple, and over all there is a dense undergrowth of vines, brambles, ferns, and deciduous shrubs.

The Seattle and Portland line of the Northern Pacific Railway crosses the river near its mouth, but elsewhere there are no railroads in the area. There is a wagon road from Castle Rock to Spirit Lake, and from it roads and trails lead in various directions. A trail follows Green River to the St. Helens mining district. The lower portion of the drainage area is well provided with wagon roads. Roads lead from Castle Rock to Silver Lake and Sightly and to points on South Fork and the rolling lands between that stream and Cowlitz River.

The first discoveries of metalliferous ores in the mining district were made in 1891 and the district was formed September 22, 1892. At the present time there is considerable activity in this region, and there is every indication that if transportation facilities were provided some valuable mining property would be developed here. The mines and proposed transportation lines to them should afford a good market for water power.

Agriculture plays no small part in this region. All along the river and on the rolling lands nearer the mouth many tracts have been cleared for diversified farming or planted to orchards. The soil is rich and the climate is favorable for fruit raising and other forms of intensive agriculture. Hay and grains are plentiful along the shores of Silver Lake, and garden vegetables, potatoes, and small fruits and berries are raised in abundance wherever the attempt has been made.

Lumbering, however, has been and probably will continue for some years to be the principal industry. Several small shingle and lumber mills are in operation, but the greater portion of the logs are transported to the larger mills on lower Cowlitz and Columbia rivers.

At present there are no developed water powers in the drainage area, but near the outlet of Spirit Lake some power rights have reached the point of preliminary construction of crib dams and diverting flumes. The properties are claimed by adverse interests, so that all work has been stopped by injunction and the respective rights are in litigation.

Spirit Lake, at the head of the main stream, has a total drainage area of 12 square miles and a normal surface area of 2.2 square miles. About 80,000 acre-feet could be developed by raising the water surface 50 feet. This is equivalent to a uniform flow of 200 second-feet for 200 days. There is no doubt that this reservoir would be filled each winter season. Silver Lake (or Toutle Lake, as it is sometimes called), in the lower portion of the area, has a drainage

area of 42 square miles and a surface area of 5.1 square miles. Its water surface could not be raised very much, but it is probable that 50,000 acre-feet could be stored. The run-off from the drainage area, however, is relatively small, and Outlet Creek, which joins it to the trunk stream, is usually dry in summer.

Toutle River is a glacial stream. The summer flow is largely supplied by the glaciers on the northern slope of Mount St. Helens. The waters from these glaciers do not flow into Spirit Lake, but reach the main stream through three tributaries from the south. Some water from the glaciers on the west side of the mountain flows into South Fork, but the contribution to that stream from this source is small. Green River is not fed by glaciers but receives its waters from surface drainage and ground storage during the summer. Its headwaters reach into the high spurs of the main range and it doubtless draws from snow banks that remain well into the summer.

During the summer of 1909 the United States Geological Survey made a water-power survey of this basin.[1] Discharge measurements were made on all the important tributaries and on the main stream at various points to determine the summer flow. The stream-flow data obtained during this investigation are included in this present report.

Toutle River has an average fall, in the 54.3 miles from Spirit Lake to its mouth, of 58.1 feet to the mile. The fall in the upper 10 miles averages 137 feet and in the lower 10 miles 19 feet to the mile. Green River, at the mouth, has an average fall of 20.8 feet to the mile, but the fall increases rapidly as the stream is ascended. South Fork, at its mouth, has an average fall of 19.2 feet to the mile, but the grade does not increase greatly until near the spurs of Mount St. Helens.

Although the stream in general flows on a gravel bed, there are many favorable localities for diversion of the water into open canals or pressure pipes. The sides of the canyon and the benches along the river afford opportunities for canal construction.

TOUTLE RIVER AT ST. HELENS, WASH.

This station was established September 11, 1909. It is located at the county bridge across Toutle River at St. Helens, Wash., in the SE. ¼ sec. 15, T. 10 N., R. 2 E., above the mouth of Alder Creek. It is 4 miles above the mouth of Green River and one-fourth mile from St. Helens post office, Wash. The gage is a vertical staff 10 feet long, graduated to feet and tenths, and fixed to the down-

[1] For the results of this investigation, including profiles of the river surveyed, see Stevens, J. C., Water powers of the Cascade Range, pt. 1, Southern Washington: Water-Supply Paper U. S. Geol. Survey No. 253, 1910.

stream end of the left abutment of the bridge. Discharge measurements are made from the highway bridge. The station was established for temporary purposes only, and observations were suspended at the close of the summer season.

Discharge measurements of Toutle River at St. Helens, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Mean velocity.	Gage height.	Discharge.
		Feet.	*Sq. ft.*	*Ft. per sec.*	*Feet.*	*Sec.-ft.*
Sept. 11	C. W. Harris	81	133	1.89	1.07	252
21	do	81	140	2.25	1.19	313

Daily gage height, in feet, of Toutle River at St. Helens, Wash., for 1909.

[Iner Fouske, observer.]

Day.	Sept.	Oct.	Day.	Sept.	Oct.	Day.	Sept.	Oct.
1		1.10	11	1.07		21	1.09	
2		1.06	12	1.05		22	1.05	
3		1.04	13	1.02		23	1.03	
4		1.03	14	1.01		24	1.05	
5			15	1.01		25	1.07	
6			16	1.02		26	1.03	
7			17	1.04		27	1.01	
8			18	1.02		28	1.03	
9			19	1.02		29	1.10	
10			20	1.10		30	1.14	

Daily discharge, in second-feet, of Toutle River at St. Helens, Wash., for 1909.

Day.	Sept.	Oct.	Day.	Sept.	Oct.	Day.	Sept.	Oct.
1		270	11	257		21	266	
2		253	12	248		22	248	
3		244	13	235		23	240	
4		240	14	231		24	248	
5			15	231		25	257	
6			16	236		26	240	
7			17	244		27	231	
8			18	235		28	240	
9			19	235		29	270	
10			20	270		30	290	

NOTE.—These discharges are based on a poorly defined rating curve.

TOUTLE RIVER NEAR CASTLE ROCK, WASH.[1]

This station was established September 4, 1909. The gage is located at the downstream end of a large rock on the left bank near the quarter corner between secs. 12 and 13, T. 10, R. 1 W.,[2] about 1½ miles southeast from Tower, Wash., and about 2½ miles below the South Fork of Toutle River and Outlet Creek. The station was established in conjunction with several others in this drainage basin for the study of low-water conditions on this stream.

[1] This station was called "near Tower" in Water-Supply Paper 253.

[2] R. 1 E., as given in Water-Supply Paper 253, is an error.

It is intended that this station shall be permanent, but as yet no facilities have been installed for making measurements at high stages. Measurements during the low-water period are made by wading.

The following discharge measurement was made by C. W. Harris:

September 4, 1909: Width, 124 feet; area, 234 square feet; gage height, 1.24 feet; discharge, 416 second-feet.

Daily gage height, in feet, of Toutle River near Castle Rock, Wash., for 1909.

[G. K. Walker, observer.]

Day.	Sept.	Oct.	Nov.	Dec.	Day.	Sept.	Oct.	Nov.	Dec.
1	.....	1.45	2.49	5.82	16	1.19	1.21	2.75	3.78
2	.....	1.35	6.1	4.95	17	1.19	1.2	2.55	3.53
3	.....	1.3	7.6	4.42	18	1.18	1.19	3.3	3.32
4	1.24	1.25	5.6	4.0	19	1.15	1.22	5.4	3.18
5	1.25	1.22	4.5	3.72	20	1.15	1.8	6.5	3.04
6	1.21	1.44	4.0	3.45	21	1.85	2.38	5.4	2.95
7	1.21	1.67	3.52	3.3	22	1.42	2.3	7.52	2.8
8	1.2	1.45	3.9	3.25	23	1.3	1.89	8.0	2.7
9	1.18	1.4	4.0	3.20	24	1.25	1.97	8.85	2.64
10	1.2	1.38	4.1	3.17	25	1.26	1.84	6.5	2.6
11	1.35	1.36	3.7	3.16	26	1.3	1.73	5.34	2.55
12	1.24	1.3	3.4	5.34	27	1.21	1.65	4.65	2.5
13	1.21	1.29	3.32	5.3	28	1.2	1.59	5.0	2.45
14	1.21	1.29	3.09	4.56	29	1.34	1.75	6.25	2.4
15	1.2	1.25	2.89	4.12	30	1.67	1.81	7.6	2.33
					31	.....	1.9	.....	2.9

Daily discharge, in second-feet, of Toutle River near Castle Rock, Wash., for 1909.

Day.	Sept.	Oct.	Day.	Sept.	Oct.	Day.	Sept.	Oct.
1	.....	468	11	442	445	21	574	.....
2	.....	442	12	415	430	22	460	.....
3	.....	430	13	408	428	23	430	585
4	415	418	14	408	428	24	418	.....
5	418	410	15	405	418	25	420	572
6	408	465	16	403	408	26	430	542
7	408	526	17	403	405	27	408	520
8	405	468	18	400	403	28	405	504
9	400	455	19	394	410	29	440	548
10	405	450	20	394	561	30	526	564
						31	.....	588

NOTE.—These discharges are based on a poorly defined rating curve.

PUGET SOUND DRAINAGE BASIN.

DESCRIPTION.

The drainage of the western slope of the Cascade Mountains in Washington is into Puget Sound. The most important streams are the Nisqually, which drains the southern portion of Mount Rainier; the Puyallup, draining the northern and western portion of Mount Rainier; White River, which drains the northern and eastern portion of Mount Rainier; Green River, the canyon of which is occupied by the Northern Pacific Railway; Cedar River, from which the city of Seattle draws its water supply; Snoqualmie River; Skykomish River, whose canyon is occupied by the Great Northern Railway; Stila-

guamish River; and Skagit River, which drains the territory between Mount Baker and the main summit of the Cascade Range.

Comparatively little is known concerning the run-off and other hydrographic characteristics of these streams. They are capable of furnishing great quantities of water power, as the fall is great, and the flow generally well sustained during the summer months. The area is perhaps one of the most densely forested sections of the United States, a large portion of the headwaters of all the streams being included within the boundaries of national forests.

The mean annual rainfall of this area varies greatly from point to point. Puget Sound has long been noted for its excessive rainfall, yet in the very midst of this area of abundant precipitation is found a small section that is almost semiarid. The mean annual rainfall at Olympia is 55 inches, at Tacoma 47, at Seattle 36. West of Seattle, on Hood Canal, the precipitation is 76 inches per annum, while 35 miles to the north, at Port Townsend, the precipitation is only 21 inches. Across Admiralty Strait from Port Townsend the rainfall is 23 inches. The country adjacent to Port Townsend lies to the northeast of the Olympic Mountains in the path of the prevailing winds of the southwest, but the winds are deprived of a large part of their moisture before Port Townsend is reached. Northeastward the precipitation gradually increases again, and at Marblemount it is 47 inches per annum. The only reliable records of precipitation near the summit of the Cascades have been obtained at Snoqualmie Falls, where, at an elevation of 438 feet, the precipitation is 60 inches. It is probable that on the summit of the Cascades the annual precipitation is 120 inches or more. A large part of the precipitation in this portion of the country falls during the nine months from September to May. On the summit of the Cascades it is mostly snowfall. Snow deposits during a single winter frequently aggregate 40 feet or more. When these snows disappear in the spring, high waters may be expected in all streams draining these mountains. The regular spring run-off, however, is rarely high enough to do a great amount of damage, as the streams are very steep and carry the water away rapidly. Climatic influences, however, frequently combine to cause very destructive floods. These usually occur in the fall after the first heavy snowfall, and are caused by chinook winds from the southwest when accompanied by rain. These winds are annual occurrences, but only when they follow a heavy precipitation of early snow do they cause damaging floods.

The only complete records of run-off are those obtained on Cedar River. From these records it appears that the year 1905 was an exceptionally low year as far as run-off was concerned, and 1903 a wet year.

CEDAR RIVER NEAR RAVENSDALE, WASH.

This station was established September 27, 1902. It is located at the intake of the pipe line which furnishes water to the city of Seattle. It is 15 miles below Clear Lake and 3 miles north of Ravensdale.

The data obtained at this station are of great value, as they are continuous and reliable and constitute practically the only stream-flow data on the western slope of the Cascade Range in Washington. The flow is obtained from the formula $Q=3.75LH^{3/2}+35$. The gage heights represent the head of water (H) on the crest of the dam. The length of the crest (L) is 120 feet. The crest is steel shod and of triangular section. The upstream slope forms an angle of 30° with the horizontal and the downstream slope an angle of 60°. For this dam a mean of the coefficient obtained from the current-meter measurements made from 1902 to 1906 gives a value of $c=3.76$, while the mean obtained from a set of weir experiments for a dam of similar type is approximately 3.73. (See Water-Supply Paper 200, Pl. X, series 140.) In computing the rating table c has been given the value of 3.75. The quantity 35 is added as the amount diverted into the pipe line. This diversion varies within small limits, but 35 second-feet has been used throughout in computing the run-off for this area. (For a description of the measurement of the amount diverted see Trans. Am. Soc. Civil Eng., vol. 49, p. 112.) The datum of the gage was set to coincide with the crest of the dam at an elevation of 436 feet above sea level. The gage had not been checked for several years until April, 1911, when it was found to read 0.11 foot too high. It is not known when the change occurred, so 1909 gage heights have not been corrected. The amount of water diverted in the pipe lines has also been somewhat greater than 35 second-feet since the completion in 1909 of the new pipe line with a capacity of 70 second-feet.

No current-meter measurements were made during 1909.

Daily gage height, in feet, of Cedar River near Ravensdale, Wash., for 1909.

[George Landsburg, observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.54	1.11	1.42	1.41	1.72	2.08	1.08	0.76	0.71	0.77	0.88	3.57
2	1.42	1.08	1.40	1.41	1.68	2.40	1.07	.75	.70	.74	1.87	2.88
3	1.44	1.10	1.35	1.37	1.65	2.36	1.05	.75	.70	.72	2.46	2.36
4	1.55	1.11	1.34	1.34	1.83	2.27	1.04	.75	.71	.70	2.86	2.14
5	1.68	1.07	1.33	1.31	1.93	2.17	1.02	.74	.72	.68	2.72	1.93
6	1.73	1.06	1.34	1.29	1.89	2.05	1.0	.74	.72	.69	2.45	1.76
7	1.62	1.05	1.26	1.26	1.79	1.90	1.04	.73	.73	.72	2.10	1.66
8	1.51	1.04	1.21	1.24	1.67	1.87	1.04	.75	.73	.73	1.91	1.64
9	1.44	1.04	1.20	1.17	1.59	1.77	1.02	.75	.72	.74	1.88	1.63
10	1.33	1.03	1.19	1.17	1.58	1.84	1.02	.76	.72	.69	1.35	1.62
11	1.21	1.03	1.17	1.17	1.57	1.91	1.04	.75	.71	.67	1.27	1.54
12	1.12	1.00	1.16	1.18	1.59	1.87	1.04	.74	.70	.66	1.23	1.49
13	1.10	1.02	1.15	1.19	1.61	1.76	1.03	.73	.69	.70	1.12	1.86
14	1.08	1.02	1.13	1.19	1.62	1.75	1.01	.72	.68	.72	1.11	2.94
15	1.05	1.02	1.12	1.18	1.55	1.70	.98	.72	.67	.71	1.12	2.75

Daily gage height, in feet, of Cedar River near Ravensdale, Wash., for 1909—Continued.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
16	1.03	1.20	1.12	1.17	1.49	1.63	.97	.71	.66	.70	1.35	2.32
17	1.23	1.44	1.14	1.17	1.47	1.58	.95	.69	.72	.67	1.54	2.07
18	1.32	1.74	1.14	1.16	1.47	1.53	.87	.75	.75	.66	1.90	1.87
19	1.64	1.95	1.13	1.15	1.43	1.51	.84	.74	.78	.66	3.63	1.66
20	2.52	1.85	1.12	1.14	1.42	1.46	.84	.73	.79	.65	4.12	1.52
21	2.51	1.77	1.11	1.12	1.41	1.44	.83	.72	.75	.66	3.03	1.46
22	2.21	1.68	1.09	1.11	1.36	1.41	.82	.72	.71	.67	3.14	1.36
23	2.14	1.54	1.02	1.09	1.32	1.36	.81	.71	.72	.76	5.39	1.29
24	1.88	1.44	1.05	1.07	1.27	1.27	.78	.69	.71	.74	5.85	1.22
25	1.62	1.56	1.10	1.04	1.41	1.19	.75	.68	.71	.73	4.46	1.19
26	1.57	1.45	1.11	1.54	1.51	1.22	.75	.67	.70	.69	3.43	1.15
27	1.40	1.56	1.10	1.73	1.57	1.20	.74	.69	.68	.66	2.74	1.10
28	1.36	1.42	1.10	1.84	1.72	1.12	.73	.72	.62	.68	2.84	1.11
29	1.21	.....	1.11	1.75	1.89	1.10	.74	.73	.77	.69	3.65	1.13
30	1.20	.....	1.13	1.66	1.91	1.09	.75	.72	.78	.70	4.36	1.26
31	1.18	.....	1.25	.....	2.02	.....	.77	.71	.....	.70	.....	1.17

Daily discharge, in second-feet, of Cedar River near Ravensdale, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	894	562	796	788	1,050	1,390	541	336	306	342	408	3,060
2	796	541	780	788	1,070	1,700	534	330	300	324	1,190	2,230
3	812	555	740	756	990	1,660	520	330	300	312	1,760	1,660
4	902	562	732	732	1,150	1,580	513	330	306	300	2,200	1,440
5	1,020	534	724	708	1,240	1,480	499	324	312	289	2,040	1,240
6	1,060	527	732	692	1,210	1,360	485	324	312	294	1,760	1,090
7	963	520	670	670	1,120	1,220	513	318	318	312	1,400	1,000
8	868	513	633	655	1,010	1,190	513	330	318	318	1,220	980
9	812	513	625	604	936	1,100	499	330	312	324	1,200	972
10	724	506	618	604	928	1,160	499	336	312	294	740	963
11	633	506	604	604	920	1,220	513	330	306	284	678	894
12	569	485	597	611	936	1,190	513	324	300	278	648	852
13	555	499	590	618	954	1,090	506	318	294	300	569	1,180
14	541	499	576	618	963	1,080	492	312	289	312	562	2,300
15	520	499	569	611	902	1,040	472	312	284	306	569	2,080
16	506	625	569	604	852	970	465	306	278	300	740	1,620
17	647	812	583	604	836	928	452	294	312	284	894	1,380
18	716	1,070	583	597	836	886	402	330	330	278	1,220	1,190
19	981	1,260	576	590	804	868	384	324	348	278	3,140	1,090
20	1,830	1,170	569	583	796	828	384	318	354	272	3,800	877
21	1,820	1,100	562	569	788	812	378	312	330	278	2,400	828
22	1,510	1,020	548	562	748	788	372	312	306	284	2,530	748
23	1,440	894	499	548	716	748	366	306	312	336	5,680	693
24	1,200	812	520	534	678	678	348	294	306	324	6,420	640
25	963	911	555	513	788	618	330	289	306	318	4,290	618
26	918	820	562	894	868	640	330	284	300	294	2,890	590
27	780	911	555	1,060	920	625	324	294	289	278	2,070	555
28	748	796	555	1,160	1,050	569	318	312	256	289	2,180	562
29	633	.....	562	1,080	1,210	555	324	318	342	294	3,160	576
30	625	.....	576	1,000	1,220	548	330	312	348	300	4,150	670
31	610	.....	662	.....	1,330	.....	342	306	.....	300	.....	604

NOTE.—These discharges are based on the weir formula $Q=3.75\ LH^{\frac{3}{2}}+35$. The coefficient 3.75 was determined from discharge measurements made during 1902–1906.

Monthly discharge of Cedar River near Ravensdale, Wash., for 1909.

[Drainage area, 170 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	1,830	506	890	5.24	6.04	54,700	B.
February	1,260	485	715	4.21	4.38	39,700	B.
March	796	499	614	3.61	4.16	37,800	B.
April	1,160	513	699	4.11	4.59	41,600	B.
May	1,330	678	960	5.65	6.51	59,000	B.
June	1,700	548	1,020	6.00	6.69	60,700	B.
July	541	318	434	2.55	2.94	26,700	C.
August	336	284	316	1.86	2.14	19,400	C.
September	354	256	310	1.82	2.03	18,400	C.
October	342	272	300	1.76	2.03	18,400	C.
November	6,420	408	2,080	12.2	13.61	124,000	B.
December	3,060	555	1,130	6.65	7.67	69,500	B.
The year	6,420	256	789	4.64	62.79	570,000	

NOTE.—The summer flow is influenced somewhat by storage in Cedar Lake.

SKAGIT RIVER NEAR MARBLEMOUNT, WASH.

This station was established December 21, 1908, and is maintained in cooperation with the Skagit Power Co. The station is located 800 feet above the point known as the "Corner," at the mouth of the canyon, about 1 mile above the mouth of Goodell Creek and about 26 miles above Rockport, the nearest railway station. The river is subject to enormous floods that do a great deal of damage in the lower portions of the stream, and any attempt to remedy the conditions will require a thorough knowledge of the discharge of the river.

The gage is a vertical staff on the right bank in the measuring section. Measurements are made from a cable and car. The banks of the stream are high and rocky and will not overflow. The bed is composed of granite bowlders and is very rough, although in the immediate section where measurements are made the river flows quite smoothly.

Discharge measurements of Skagit River near Marblemount, Wash., in 1908–9.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1908		*Feet.*	*Sq. ft.*	*Feet.*	*Sec. ft.*
Dec. 21	G. L. Rogers		630	1.70	1,690
22	do		630	1.70	1,690
23	do			1.60	1,570
24	do		630	1.60	1,680
28	M. S. Halstead		760	2.37	2,520
29	do		726	2.23	2,380
30	do		696	2.20	2,020
31	do		653	1.90	1,840
1909.					
Jan. 1	Halstead	145	625	1.70	1,670
2	do	145	671	1.85	1,830
3	do	145	727	2.22	2,370
4	do	145	694	2.05	2,000
Feb. 3	L. R. Allen	164	720	1.97	1,870
3	do	164	716	1.96	1,870

Discharge measurements of Skagit River near Marblemount, Wash., in 1908–9—Contd.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
Feb. 15	Halstead	142	608	1.33	1,380
20	Halstead & Babcock	158	687	1.80	1,750
25	Halstead & Rogers	143	636	1.52	1,490
Mar. 27	Halstead	158	832	2.41	2,440
30	do	158	881	2.70	2,710
Apr. 1	G. L. Rogers	170	988	3.28	3,520
May 3	do	185	1,310	4.64	6,010
4	do	185	1,560	6.00	8,530
11	do	185	1,220	4.15	5,070
30	do	195	1,770	6.98	10,400
June 7	do	200	1,960	7.72	13,000
21	J. C. Stevens	199	1,990	7.90	13,500
July 1	J. E. Rossell	203	1,730	6.80	10,300
13	G. L. Rogers	200	1,600	6.00	8,260
19	do	195	1,340	4.69	5,820
Aug. 5	do	185	1,090	3.70	4,220
28	J. E. Rossell	182	1,030	3.46	3,690
30	do	182	990	3.15	3,270
Sept. 13	G. L. Rogers	200	879	2.52	2,490
Oct. 30	do	145	695	1.62	1,660
Dec. 15	J. E. Rossell	185	1,310	3.90	4,570

Daily gage height, in feet, of Skagit River near Marblemount, Wash., for 1909.

[Skagit Power Co., observer.]

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1.70	1.60	1.46	3.28	3.20	10.31	6.83	4.62	3.35	2.20	1.88	9.75
2	1.85	1.72	1.40	3.08	3.60	11.82	6.72	4.17	3.60	2.00	3.44	7.75
3	2.22	1.97	1.38	2.98	4.74	10.95	6.88	4.21	3.80	1.88	4.72	6.38
4	2.05	1.94	1.44	2.80	5.95	9.76	7.46	4.17	3.95	1.84	3.64	5.40
5	1.75	1.88	1.40	2.66	5.56	8.95	6.94	3.77	4.01	2.02	3.06	4.90
6	1.70	1.82	1.36	2.52	4.96	8.38	7.94	3.61	3.94	3.12	2.68	4.50
7	1.65	1.73	1.32	2.47	4.54	7.80	8.19	3.54	3.49	2.52	2.46	4.16
8	1.65	1.68	1.32	2.40	4.26	7.95	7.40	3.60	3.22	2.16	2.40	3.96
9	1.66	1.62	1.28	2.64	4.41	8.48	7.42	3.61	3.03	3.35	2.30	3.62
10	1.60	1.60	1.25	2.72	4.33	9.39	7.09	3.69	3.49	3.29	2.22	3.40
11	1.60	1.50	1.26	2.74	4.14	9.98	7.22	3.55	2.73	2.99	2.04	3.22
12	1.55	1.39	1.32	2.92	4.13	10.16	6.64	3.66	2.48	2.88	2.01	5.35
13	1.60	1.33	1.47	3.16	4.42	9.24	6.02	3.69	2.55	3.10	1.89	4.83
14	1.70	1.31	1.60	3.19	4.94	8.62	5.92	3.92	2.42	2.74	1.72	4.20
15	1.85	1.33	1.70	3.15	5.17	9.05	6.18	3.85	2.41	2.35	1.62	3.80
16	1.90	1.61	1.84	3.05	5.22	8.72	6.12	3.37	2.62	2.09	1.63	3.49
17	2.00	1.93	1.94	2.86	5.34	8.35	5.44	3.21	2.59	1.91	1.70	3.28
18	2.20	1.90	1.92	2.76	5.54	8.00	5.00	3.45	2.12	1.82	4.20	3.05
19	2.90	1.88	1.90	2.74	5.90	8.06	4.72	3.66	1.94	1.80	7.70	2.91
20	3.90	1.80	1.84	2.79	5.68	7.90	4.78	3.71	2.76	1.85	5.68	2.71
21	3.25	1.68	1.76	2.79	5.24	7.85	4.90	3.15	2.44	1.79	4.59	2.46
22	2.90	1.61	1.74	2.94	4.97	7.29	5.46	2.92	2.15	1.70	4.75	2.30
23	2.50	1.54	1.74	3.05	5.20	6.84	5.57	2.76	2.11	2.07	10.85	2.20
24	2.32	1.54	1.83	3.19	6.20	6.52	5.40	2.68	2.15	2.27	10.45	2.17
25	2.22	1.52	1.96	3.38	7.20	6.34	5.04	2.53	2.38	2.00	7.86	2.11
26	2.09	1.49	2.16	3.59	8.18	6.64	4.66	6.56	2.22	1.88	6.40	2.05
27	1.94	1.52	2.42	3.57	8.24	6.86	4.79	4.34	1.88	1.74	5.42	1.94
28	1.85	1.44	2.51	3.48	7.86	6.34	4.76	3.48	2.24	1.70	7.66	1.84
29	1.72	.....	2.62	3.32	7.44	6.20	4.95	3.25	3.07	1.76	16.00	1.90
30	1.70	.....	2.70	3.20	6.92	6.55	5.01	3.12	2.51	1.65	15.00	2.30
31	1.64	.....	3.00	.....	7.57	.....	4.87	3.12	.....	1.83	.....	2.26

Daily discharge, in second-feet, of Skagit River near Marblemount, Wash., for 1909.

Day.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	1,640	1,560	1,460	3,510	3,390	21,400	10,700	5,830	3,620	2,120	1,790	19,400
2	1,760	1,660	1,420	3,210	4,010	27,400	10,400	4,980	4,010	1,910	3,750	13,200
3	2,140	1,880	1,410	3,070	6,060	23,800	10,800	5,050	4,330	1,790	6,020	9,530
4	1,960	1,850	1,450	2,840	8,530	19,400	12,400	4,980	4,580	1,760	4,070	7,370
5	1,680	1,790	1,420	2,660	7,710	16,700	10,900	4,280	4,690	1,930	3,180	6,360
6	1,640	1,740	1,390	2,480	6,470	15,000	13,700	4,030	4,570	3,270	2,680	5,600
7	1,600	1,660	1,360	2,420	5,680	13,300	14,500	3,910	3,830	2,480	2,410	4,960
8	1,600	1,620	1,360	2,340	5,140	13,800	12,200	4,010	3,420	2,080	2,340	4,600
9	1,610	1,580	1,340	2,630	5,430	15,300	12,200	4,030	3,140	3,620	2,230	4,040
10	1,560	1,560	1,320	2,740	5,280	18,200	11,300	4,150	3,830	3,520	2,140	3,690
11	1,560	1,490	1,330	2,760	4,920	20,100	11,700	3,930	2,750	3,090	1,950	3,420
12	1,520	1,410	1,360	3,000	4,900	20,800	10,200	4,110	2,440	2,940	1,920	7,260
13	1,560	1,370	1,470	3,330	5,450	17,700	8,690	4,150	2,520	3,240	1,800	6,230
14	1,640	1,360	1,560	3,380	6,440	15,700	8,460	4,530	2,360	2,760	1,660	5,030
15	1,760	1,370	1,640	3,320	6,890	17,100	9,050	4,420	2,350	2,280	1,580	4,330
16	1,810	1,570	1,760	3,170	6,990	16,000	8,920	3,640	2,610	2,000	1,580	3,830
17	1,910	1,840	1,850	2,920	7,240	14,900	7,450	3,400	2,570	1,820	1,640	3,510
18	2,120	1,810	1,830	2,790	7,660	13,900	6,550	3,770	2,030	1,740	5,030	3,170
19	2,970	1,790	1,810	2,760	8,420	14,100	6,020	4,110	1,850	1,720	13,000	2,980
20	4,500	1,720	1,760	2,830	7,960	13,600	6,130	4,190	2,790	1,760	7,960	2,720
21	3,460	1,620	1,690	2,830	7,030	13,500	6,360	3,320	2,390	1,710	5,770	2,410
22	2,970	1,570	1,670	3,020	6,490	11,900	7,500	3,000	2,060	1,640	6,080	2,230
23	2,460	1,520	1,670	3,170	6,950	10,700	7,730	2,990	2,020	1,980	23,400	2,130
24	2,250	1,520	1,750	3,380	9,100	9,870	7,370	2,680	2,060	2,200	21,900	2,090
25	2,140	1,500	1,870	3,660	11,600	9,440	6,630	2,500	2,320	1,910	13,500	2,020
26	2,000	1,480	2,080	3,990	14,400	10,200	5,900	9,970	2,140	1,790	9,580	1,960
27	1,850	1,500	2,360	3,960	14,600	10,700	6,150	5,300	1,790	1,670	7,410	1,850
28	1,760	1,450	2,470	3,820	13,500	9,440	6,090	3,820	2,160	1,640	12,900	1,760
29	1,660	.....	2,610	3,570	12,300	9,100	6,460	3,460	3,200	1,690	47,200	1,810
30	1,640	.....	2,710	3,390	10,900	9,940	6,570	3,270	2,470	1,600	42,000	2,230
31	1,590	.....	3,100	.....	12,700	.....	6,300	3,270	.....	1,750	.....	2,190

NOTE.—These discharges are based on a rating curve that is well defined between 1,350 and 14,000 second-feet.

Monthly discharge of Skagit River near Marblemount, Wash., for 1909.

[Drainage area, 1,090 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
January	4,500	1,520	2,010	1.48	2.12	124,000	A.
February	1,880	1,360	1,600	1.47	1.53	88,800	A.
March	3,100	1,320	1,750	1.61	1.86	108,000	A.
April	3,990	2,340	3,100	2.84	3.17	184,000	A.
May	14,600	3,390	7,880	7.23	8.34	485,000	A.
June	27,400	9,100	15,100	13.90	15.51	898,000	A.
July	14,500	5,900	8,880	8.15	9.40	546,000	A.
August	9,970	2,500	4,160	3.82	4.40	256,000	A.
September	4,690	1,790	2,890	2.65	2.96	172,000	A.
October	3,620	1,600	2,170	1.99	2.29	133,000	A.
November	47,200	1,580	8,620	7.91	8.82	513,000	A.
December	19,400	1,760	4,640	4.26	4.91	285,000	A.
The year	47,200	1,320	5,240	4.81	65.31	3,790,000	

CASCADE RIVER NEAR MARBLEMOUNT, WASH.

This station was established March 8, 1908, by the Skagit Power Co., which installed the equipment and furnishes gage readings and most of the discharge measurements. It is located 8 miles above the

mouth of Cascade River and the same distance above Marblemount, Wash. It is at a proposed site for a dam and power plant. Above this point the river grade is comparatively flat and considerable storage can be developed here.

Three gages have been read, as follows: Gage No. 1 at a foot log below the camp of the power company. This gage was used from March 8 to March 31, 1909. Gage No. 2 was installed April 1, 1909, about 6 miles downstream and set to read the same as No. 1. As the river grade is very flat they are assumed to read the same at all stages. It was in use from April 1 to May 24, 1909. Gage No. 3 was put in May 25, 1909, and used the rest of the year. It is 500 feet above the location of No. 1, which had washed out. On June 1, 1909, the station was moved to gage No. 3. Rating curves have been developed for the three gages. Gage No. 3 is a vertical staff on the right bank 100 feet upstream from the cable from which measurements are made. The channel in the vicinity of the station is straight; the banks are too high to overflow. The bed of the stream is of gravel and cobblestones and permanent except during extreme high water. The water at all stages is comparatively swift and the bed is rough. On this account it is necessary to obtain a relatively large number of measurements, as the individual errors of each measurement are comparatively large.

Discharge measurements of Cascade River near Marblemount, Wash., in 1909.

Date.	Hydrographer.	Width.	Area of section.	Gage height.	Discharge.
1909.		*Feet.*	*Sq. ft.*	*Feet.*	*Sec.-ft*
Mar. 8	Jesse E. Rossell	71	160	[a] 1.00	344
Apr. 22	do	71.5	183	[a] 1.40	500
22	do	80	315	[b] 1.40	579
May 6	do	85	372	[b] 2.10	1,010
21	do	85	370	[b] 1.97	960
June 3	do	100	429	4.10	2,780
19	do	105	369	3.50	2,520
22	J. C. Stevens	102	271	2.93	1,510
July 15	Jesse E. Rossell	106	321	3.30	2,000
19	do	100	230	2.50	1,200
21	do	102	245	2.65	1,370
28	do	103	238	2.57	1,330
Aug. 12	do	100	219	2.38	986
20	do	100	206	2.25	906
25	do	102	221	2.40	1,030
Sept. 5	do	102	233	2.53	1,180
12	do	93	137	1.70	582
23	do	95	148	1.80	667
Oct. 12	do	95	167	2.02	823
Nov. 10	do	95	152	1.80	666

[a] Gage No. 1. [b] Gage No. 2.

NOTE.—Gage heights to measurements beginning June 3, 1909, refer to gage No. 3.

Daily gage height, in feet, of Cascade River near Marblemount, Wash., for 1909.

[Jesse E. Rossell, jr., observer.]

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	1.6	1.47	5.57	3.40	2.48	2.35	1.86	1.78	4.78
2	.....	1.6	2.00	6.05	3.30	2.31	2.48	1.72	4.30	3.68
3	.....	1.6	2.70	4.10	3.56	2.40	2.45	1.65	5.20	3.15
4	.....	1.5	2.80	4.10	3.75	2.40	2.52	1.58	3.35	2.78
5	.....	1.5	2.43	3.48	3.83	2.19	2.48	1.74	2.45	2.62
6	.....	1.3	2.10	3.40	3.94	2.15	2.52	2.70	2.05	2.52
7	.....	1.3	2.00	3.10	3.72	2.15	2.29	2.04	2.11	2.35
8	1.0	1.3	1.90	3.45	3.20	2.20	2.08	1.80	2.02	2.14
9	1.0	1.4	1.93	3.68	3.62	2.26	2.02	2.08	1.92	2.03
10	1.0	1.5	1.85	4.02	3.40	2.22	2.38	2.26	1.80	1.92
11	1.0	1.4	1.75	4.42	4.45	2.20	1.90	2.12	1.74	1.92
12	1.0	1.3	1.70	4.00	3.55	2.30	1.65	2.02	1.68	4.85
13	1.1	1.5	1.74	3.60	3.18	2.36	1.88	2.24	1.58	3.30
14	1.1	1.6	1.90	3.45	3.18	2.34	1.82	1.81	1.49	2.76
15	1.1	1.55	2.05	4.05	3.30	2.34	1.85	1.68	1.46	2.49
16	1.1	1.5	2.05	3.46	3.28	2.06	2.08	1.64	1.41	2.32
17	1.1	1.45	2.10	3.50	2.72	2.14	2.04	1.53	1.52	2.18
18	1.1	1.4	2.50	3.30	2.65	2.24	1.64	1.50	4.70	2.08
19	1.1	1.4	2.50	3.50	2.50	2.38	1.52	1.52	5.35	2.00
20	1.1	1.4	2.20	3.33	2.62	2.26	2.30	1.53	5.25	1.86
21	1.0	1.4	1.97	3.10	2.68	2.09	2.06	1.50	3.55	1.74
22	1.0	1.4	2.07	2.93	3.32	1.98	1.79	1.47	4.10	1.66
23	1.0	1.4	2.15	2.95	3.04	1.89	1.82	1.65	6.75	1.59
24	1.0	1.4	2.72	3.03	2.88	1.89	1.98	1.68	5.32	1.54
25	1.1	1.5	3.20	2.88	2.72	2.22	2.02	1.72	3.80	1.50
26	1.2	1.73	3.50	3.07	2.62	3.74	1.76	1.56	3.30	1.47
27	1.6	1.68	3.93	2.93	2.71	2.47	1.74	1.40	2.82	1.44
28	1.6	1.60	3.05	2.85	2.58	2.15	2.00	1.50	7.55	1.42
29	1.3	1.53	2.90	2.93	2.84	2.15	2.00	1.52	13.50	1.39
30	1.3	1.47	3.43	3.30	2.74	2.10	2.08	1.60	7.05	1.46
31	2.3	.....	3.38	.....	2.62	2.16	.....	1.68	.....	1.47

NOTE.—Gage readings refer to the three gages used (see description) as follows: Gage No. 1, Mar. 8 to 31; gage No. 2, Apr. 1 to May 24; gage No. 3, May 25 to Dec. 31.

Daily discharge, in second-feet, of Cascade River near Marblemount, Wash., for 1909.

Day.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.....	605	535	5,340	2,020	1,140	1,040	676	628	3,890
2	.....	605	850	6,310	1,900	1,010	1,140	592	3,100	2,360
3	.....	605	1,430	2,880	2,210	1,080	1,120	555	4,600	1,740
4	.....	550	1,520	2,880	2,440	1,080	1,180	521	1,960	1,380
5	.....	550	1,190	2,120	2,540	912	1,140	604	1,120	1,200
6	.....	455	920	2,020	2,670	880	1,180	1,320	805	1,180
7	.....	455	850	1,680	2,400	880	952	798	848	1,040
8	344	455	780	2,080	1,790	920	826	640	784	872
9	344	500	801	2,300	2,280	968	784	1,300	714	791
10	344	550	750	2,770	2,020	936	1,060	968	640	714
11	344	500	690	3,330	3,370	920	700	856	604	714
12	344	455	660	2,750	2,200	1,000	555	784	570	4,030
13	378	550	684	2,260	1,770	1,030	688	952	521	1,900
14	378	605	780	2,080	1,770	1,030	652	646	480	1,370
15	378	578	885	2,810	1,900	1,030	670	570	467	1,150
16	378	550	885	2,090	1,880	812	826	550	444	1,020
17	378	525	920	2,140	1,340	872	798	498	494	904
18	378	500	1,250	1,900	1,280	952	550	485	3,790	826
19	378	500	1,250	2,140	1,160	1,060	494	494	4,900	770
20	378	500	1,000	1,940	1,260	968	1,000	498	4,700	676
21	344	500	829	1,680	1,300	833	812	485	2,200	604
22	344	500	899	1,520	1,920	756	634	472	2,880	560
23	344	500	960	1,540	1,620	694	652	555	7,870	526
24	344	500	1,450	1,610	1,470	694	756	570	4,820	503
25	378	550	1,790	1,470	1,340	936	784	592	2,500	485
26	415	678	2,140	1,650	1,260	2,430	616	512	1,900	472
27	605	649	2,600	1,520	1,330	1,140	604	480	1,420	458
28	605	605	1,630	1,440	1,220	880	770	485	9,790	449
29	455	666	1,490	1,520	1,440	880	1,240	494	31,700	436
30	455	535	2,000	1,900	1,350	840	826	530	8,590	467
31	1,080	.....	2,000	.....	1,240	888	.....	570	.....	472

NOTE.—These discharges are based on rating curves applicable as follows: Mar. 8 to May 24, fairly well defined; May 25 to Dec. 31, fairly well defined from 550 to 3,000 second-feet.

Monthly discharge of Cascade River near Marblemount, Wash., for 1909.

[Drainage area, 222 square miles.]

Month.	Discharge in second-feet.				Run-off.		Accuracy.
	Maximum.	Minimum.	Mean.	Per square mile.	Depth in inches on drainage area.	Total in acre-feet.	
March (8-31)	1,080	344	421	1.90	1.69	20,000	A.
April	678	455	543	2.45	2.73	32,300	B.
May	2,660	535	1,180	5.32	6.13	72,600	B.
June	6,310	1,440	2,320	10.5	11.71	138,000	B.
July	3,370	1,160	1,800	8.11	9.35	111,000	B.
August	2,430	694	983	4.43	5.11	60,400	A.
September	1,240	494	836	3.77	4.21	49,700	A.
October	1,320	472	647	2.91	3.36	39,800	A.
November	31,700	444	3,530	15.9	17.74	210,000	B.
December	4,000	436	1,100	4.95	5.71	67,600	B.
The period						801,000	

MISCELLANEOUS MEASUREMENTS.

The following miscellaneous discharge measurements have been made on streams in the north Pacific coast drainage basins during 1909. They are arranged in the same order of drainage basins as the regular stations:

Miscellaneous measurements in Columbia River drainage basin.

Clark Fork basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
May 25	Sullivan Creek	Little Bitterroot Creek	Dayton, Mont.		8.6
July 28	do	do	do		15.9
Aug. 7	Crow Creek	Flathead River	T. 20 N., R. 21 W.	1.58	89.7
13	do	do	do	1.48	78.8
Sept. 17	do	do	do	1.30	61.6
Aug. 3	North Fork of Crow Creek.	Crow Creek	Ronan, Mont.	2.11	28.0
Sept. 10	do	do	do	1.80	12.1
Apr. 21	Spring Creek	do	do		16.9
May 27	do	do	do		17.6
June 19	do	do	do		19.4
Aug. 3	Mission Creek	Flathead River	Dam site above St. Ignatius, Mont.	1.25	87.5
16	do	do	do	1.06	66.8
Sept. 9	do	do	do	.87	52.6
29	do	do	do	1.08	63.3
Apr. 20	North Fork of Post Creek.	Post Creek	Ronan, Mont.		3.4
May 27	do	do	do		11.8
June 19	do	do	do		42.5
July 25	do	do	do		21.1
Oct. 14	do	do	do		6.1
20	Spring Creek	Jocko River	Arlee, Mont.	.59	13.3

Methow River basin.

1909.					
Aug. 7	Methow River	Columbia River	8 miles above Winthrop.	(a)	390
7	Eight Mile Creek	Methow River	1 mile above mouth	(a)	120

a Furnished through courtesy of W. E. Herring, district engineer, United States Forest Service.

Miscellaneous measurements in Columbia River drainage basin—Continued.

Chelan River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
July 27	Park Creek	Stehekin River	2 miles above mouth	(a)	62
27	Bridge Creek	do	¼ mile above mouth	(a)	430
29	Railroad Creek	Chelan Lake	do	(a)	750

a Furnished through courtesy of W. E. Herring, district engineer, United States Forest Service.

Wenatchee River basin.

1909.					
Aug. 24	Icicle Creek	Wenatchee River	10 miles above mouth	(a)	262
June 12	Flume, Valley Power Co.[b]	do	Sherman Spur		26.7
12	Irrigation flume [c]	do	do		92.5

a Furnished through courtesy of W. E. Herring, district engineer, United States Forest Service.
b Flume-taking water from irrigation flume at point called "Sherman Spur," 6 miles above Cashmere, Wash.
c Measured on main canal flume at point 6 miles above Cashmere and below intake of Valley Power Co. flume.

Snake River basin.

1909.					
Apr. 18	Snake River	Columbia River	Burley, Idaho		7,385
Aug. 1	Blackfoot River	Snake River	Near mouth, Blackfoot, Idaho.	2.2	209
24	do	do	do	4.3	387
16	Raft River	do	Yale, Idaho		9.2
30	do	do	do		12.1
June 8	Goose Creek	do	Oakley, Idaho		209
Oct. 6	Trapper Creek	Goose Creek	do		14.1
28	do	do	do		12.3
June 10	Birch Creek	do	do	1.92	31.1
8	Basin Creek, No. 1	do	Basin, Idaho	2.1	12.6
8	do	do	do	2.2	14.1
9	Basin Creek, No. 2	do	do	1.63	3.72
9	Big Cottonwood Creek	Snake River	Oakley, Idaho		54.5
Aug. 24	Powder River	do	Below Eagle Creek	(a)	60
1905.					
Oct. —	Eagle Creek	Powder River	Above Little Eagle Creek.	(a)	95
1909.					
Aug. 25	do	do	do	(a)	159
24	do	do	Below Little Eagle Creek.	(a)	162
1905.					
Oct. —	Pine Creek	Snake River	Cornucopia, Oreg	(a)	135

a Furnished through courtesy of C. C. Cottrell, Baker City, Oreg.

John Day basin.

1909.					
Mar. 9	Canyon Creek	John Day River	Canyon City, Oreg		38
July 18	Dayville ditch	do	Dayville, Oreg	−3.3	1.8

Miscellaneous measurements in Columbia River drainage basin—Continued.

Deschutes River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
Apr. 25	East Fork Deschutes River.	Deschutes River	Odell, Oreg	3.4	[a] 130
June 3	West Fork Deschutes River.	do	Lava, Oreg	8.2	962
Apr. 23	Spring Creek	do	do	1.7	228
Aug. 1	Columbia Southern canal	Tumelo Creek	Laidlaw, Oreg		[b] 68
1	do	do	do		[b] 68
1	do	do	do		[c] 64
1	do	do	do		[d] 52
June 9	Stearns ditch	Crooked River	Prineville, Oreg	[e] −1.1	2.2
9	Pringle ditch	do	do	[f] −1.7	13.2
Apr. 14	Lake Creek	Metolius River	Sisters, Oreg	[g] −4.5	59
15	Jacks Creek	do	do	[h] −1.18	50
15	Canyon Creek	do	do	[i] −2.88	85
15	Eagle Creek	do	do		12

Klickitat River basin.

1909.					
Aug. 25	Klickitat River	Columbia River	Below Diamond Fork	[j] −3.60	90
20	do	do	Above Pearl Creek [k]		117
18	do	do	Above West Fork	[l] −2.76	154
31	do	do	do	[l] −2.86	143
31	do	do	Soda Ford [m]	2.24	331
Sept. 3	do	do	Above Big Muddy River	[n] −4.33	397
Oct. 29	do	do	Robertson's ranch	.65	[o] 421
Nov. 1	do	do	do	.63	[o] 436
Aug. 25	Diamond Fork of Klickitat River.	Klickitat River	Mouth	[p] −2.97	29
25	Piscoe Creek	do	do		[q] 6
21	McCreedy Creek	do	do		[q] 20
19	Pearl Creek	do	do		[q] 2
19	Chaparral Creek	do	do		[q] 1
19	Corral Creek	do	do		[q] 1
18	Swamp Creek	do	do		[q] 6
18	West Fork of Klickitat	do	1½ miles above mouth	[r] −3.10	306
31	do	do	1 mile above mouth	[r] −3.14	264
28	Little Muddy Creek	West Fork of Klickitat River.	½ mile above mouth	([s])	117
28	Clearwater Creek	Little Muddy Creek	Mouth		47
28	Fish Lake stream [t]	West Fork of Klickitat River.	do		106
16	Soda Springs Creek	Klickitat River	Soda Springs, Wash		[q] 1
16	Surveyors Creek	do	Mouth		8.4
13	Cunningham Creek	do	do		[q] 12
Sept. 3	Big Muddy Creek	do	do		[u] 341
4	Hellroaring Creek	Big Muddy River	2 miles above mouth		[v] 92

[a] At foot log 25 feet below gage.
[b] Seepage measurement 1 mile below regular station.
[c] Seepage measurement at second wasteway.
[d] Seepage measurement at crossing Bend Sisters Road.
[e] Below top of flume, right side.
[f] Below nail in upstream end of center plank of bridge, from which measurements are made.
[g] Below nail in side of foot log, left bank, 3 miles above mouth of stream.
[h] Below nail in side of foot log, left bank.
[i] Below nail in side of foot log, right bank, 75 yards above road crossing.
[j] Below 10d. nail upstream face 5-inch alder tree, right bank, 300 feet below mouth of Diamond Fork.
[k] Made 900 feet above mouth of Pearl Creek, opposite water-right notice of Klickitat Irrigation & Power Co.
[l] Below 10d. nail in upstream side, foot log near right bank, 600 feet above West Fork.
[m] Gage established on right bank, 25 feet above trail crossing 1 mile below Soda Ford, 4 miles below West Fork; excellent site for gaging station.
[n] Below cross (+) in stream face 12-inch alder tree, right bank, one-half mile above Big Muddy Creek near perpendicular basalt cliff.
[o] Furnished through courtesy of W. R. King, Portland, Oreg.
[p] Below 10d. nail downstream face cottonwood tree, left bank, 150 feet above U. S. B. M. marked 3,368 feet.
[q] Discharge estimated.
[r] Below 10d. nail upstream face 18-inch cedar tree, right bank, one-half mile above mouth near trail crossing.
[s] Gaging one-half mile above mouth.
[t] Fish Lake stream and Little Muddy Creek unite to form West Fork. Gaging made below mouth of Clearwater Creek. Gaging at foot log 200 yards above junction with Little Muddy Creek.
[u] Discharge equals difference between Klickitat above and below Big Muddy Creek.
[v] High stage. Glacial stream. Gaging at footbridge 2 miles above mouth. Extreme high water is about 1 foot above this stage.

Miscellaneous measurements in Columbia River drainage basin—Continued.

Klickitat River basin—Continued.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
Aug. 9	Cougar Creek	Big Muddy River	Mouth near Glenwood, Wash.		*a* 3
6	Dairy Creek	Klickitat River	Mouth		*a* 4
24	Bacon Creek	do	do		*a* 8
July 31	Outlet Creek	do	At mouth at Boddo ranch.		5.7

White Salmon River basin.

1909.					
Sept. 13	White Salmon River	Columbia River	Guler, Wash	*e*—2.05	206
11	Unnamed *c*	White Salmon River	Mouth		1.5
11	do.*d*	do	do		10
13	Gotehen Creek (Eight Mile Creek).	do	do		*a* 25
23	Gilmer Creek	do	do		0
24	Rattlesnake Creek	do	do		*a* 2
24	Big Spring Creek	do	do		10
25	Little Buck Creek	do	do		4
25	Unnamed *e*	do	do		1

Irrigating ditches in White Salmon River basin.

Name of ditch.	Location of head gate.	Bank of stream.	Approximate capacity.
Diverting from White Salmon River:			*Sec.-feet.*
Wagnitz	NE. ¼ sec. 3, T. 6, R. 10	Right	3
Thomas	NW. ¼ sec. 14, T. 6, R. 10	do	2
Coats and Duncan	do	Left	10
Coats Bros	SE. ¼ sec. 14, T. 6, R. 10	do	5
Dutch	do	do	5
Pearson	do	do	5
Huber	SE. ¼ sec. 24, T. 6, R. 10	Right	3
Trout Lake	NE. ¼ sec. 31, T. 6, R. 11	Left	25
Diverting from Trout Creek:			
McDonald	NE. ¼ sec. 22, T. 6, R. 10	Right	8
Pearson-Thompson	do	do	7

Little White Salmon River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
Oct. 3	Little White Salmon River.	Columbia River	Above Moss Creek		13
3	do	do	Below Moss Creek	*f*—2.66	44
3	do	do	Below Lava Creek	*g*— .11	46
3	Moss Creek	Little White Salmon River.	Mouth		*h* 31
3	Lava Creek	do	do		3.6

a Discharge estimated.
b Below 10-d. nail in stream face of small alder on left bank, 100 feet below bridge at trail crossing 1 mile north of south boundary line of Columbia national forest.
c Tributary from left 4.8 miles above boundary line of national forest.
d Tributary from left 3.8 miles above boundary line of national forest.
e Tributary from left, 3.5 miles above mouth of White Salmon River.
f Water surface below 10-d. nail in stream face of upstream pile in left abutment of bridge.
g Below zero of gage, right bank, above old weir installed by Portland Railway, Light & Power Co. Length of weir, 16.2 feet; head on weir, 0.91 foot; computed discharge, 47.2 second-feet.
h Discharge equals difference between that obtained on Little White Salmon River above and below this stream.

Miscellaneous measurements in Columbia River drainage basin—Continued.

Lewis River basin.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
Aug. 12	Lewis River	Columbia River	15 miles above mouth of Muddy River.	(a)	243
July 21	Cougar Creek	North Fork of Lewis River.	Cougar, Wash	b 0.52	105
21	Siouxon Creek	do	Yale, Wash		46

Cowlitz River basin.

Sept. 18	North Fork Toutle River.	Toutle River	Spirit Lake	c—7.76	30
10	Green River	North Fork Toutle River	Lithow, Wash	d—4.62	56
7	South Fork Toutle River.	Toutle River	Toutle County building.	e—5.49	87
—	Lake Creek	do	Outlet Packwood Lake	(f)	140

a Water surface marked by notch cut in cedar log buried in bed on left bank at foot of falls.
b Gaging at foot log back of Schroder's house.
c Below United States Geological Survey bench mark No. 8, Toutle River survey, made at spillway of upper dam. Water surface below spike in root of 18-inch white fir on right bank 20 feet above dam.
d Below bench mark No. 5, Toutle River Survey. Water surface below 10d. nail in lower board of left abutment of bridge, upstream end. Measurement made by wading 300 feet below highway bridge.
e Below bench mark No. 10, Toutle River survey. Water surface below lowest rivet of upper longitudinal seam on northwest side of northwest tube of middle pier of country bridge.
f Furnished through the courtesy of W. E. Herring, district engineer, United States Forest Service.

Miscellaneous measurements in Puget Sound drainage basins.

Date.	Stream.	Tributary to—	Locality.	Gage height.	Discharge.
1909.				*Feet.*	*Sec.-ft.*
July —	Skagit River	Puget Sound	¼ mile below Lightning Creek.a		3,286
19	Glacier Creek	Skagit River	1½ miles above mouth a		68
21	Lightning Creek	do	1 mile above mouth b		890
19	Devils Creek	do	1½ miles above mouth b		308
18	Big Beaver Creek	do	Mouth c		700
16	Ruby Creek	do	do		1,260
24	Thunder Creek	do	7 miles above mouth d		1,600
15	Stetattle Creek	do	Mouth		526
	Clear Creek	do	do		651
July 12	Nu Waalem Creek	do	2 miles above mouth		620
8	Goodell Creek	do	½ mile above mouth		465
8	Bacon Creek	do	Mouth e		337
Apr. 8	North Fork Cascade River.	Cascade River	2 miles above mouth		135
Aug. 19	Marble Creek	do	Mouth f		80
May 11	Sauk River	Skagit River	1 mile above Whitechuck		1,400
11	Whitechuck Creek	Sauk River	Mouth g		360
	Suiattle River	do	1 mile below Downey Creek. h		1,402
June 27	do	do	3 miles above mouth		3,000
28	Buck Creek	Suiattle River	Mouth		452
27	Tenas Creek	do	do		246
27	Big Creek	do	do		315

a Thirty miles northeast of Marblemount, Wash.
b Twenty-six miles northeast of Marblemount, Wash.
c Twenty-four miles northeast of Marblemount, Wash.
d Twenty miles northeast of Marblemount, Wash.
e Four miles northeast of Marblemount, Wash.
f Seven miles east of Marblemount, Wash.
g Six miles east of Marblemount, Wash.
h Fourteen miles southeast of Mansford, Wash.

NOTE.—Data furnished through courtesy of W. E. Herring, district engineer, United States Forest Service. All measurements at fairly high stages.

SUMMARY OF DISCHARGE PER SQUARE MILE.

Summary of mean discharge, in second-feet per square mile, in north Pacific coast drainage basins, for 1909.

Gaging station.	Drainage area (square miles).	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Rogue River near Tolo, Oreg.	2,020	5.84	3.33	1.88	1.64	1.58	1.40	0.89	0.72	0.73	0.75	4.16	2.78	2.14
Little Butte Creek near Eagle Point, Oreg.	269	4.76	2.62	1.41	.78	.61	.37	.17	.14	.17	.37	2.80	1.84	1.34
South Fork of Umpaqua River near Brockway, Oreg.	1,800	7.83	5.20	1.88	.81	.52	.37	.16	.10	.09	.17	4.51	3.32	2.08
Umpaqua River near Elkton, Oreg.	3,680	8.53	5.73	2.93	1.86	1.40	.99	.48	.33	.32	.42	5.24	4.35	2.71
Columbia River at The Dalles, Oreg.	237,000	.45	.42	.45	.62	1.01	2.83	1.98	.87	.51	.42	.53	.59	.89
Clark Fork at Newport, Wash.	24,000	.44	.52	.48	.66	1.28	4.25	2.86	1.14	.59	.48	.61	.92	1.06
Spokane River at Spokane, Wash.	4,000	1.10	1.26	1.48	2.28	3.35	3.48	1.01	.64	.55	.51	1.41	2.65	1.64
Salmon Creek near Okanogan, Wash.	152	.03	.07	.16	.18	.55	.76	.21	.3	.16	.04	.14	.08	.22
Methow River at Pateros, Wash.	1,710	.23	.23	.24	.53	1.88	4.14	1.86	.48	.26	.25	.29	.32	.90
Chelan River at Chelan, Wash.	950	.62	.65	1.29	1.60	2.96	7.96	5.63	1.54	1.24	.85	1.01	1.84	2.27
Wenatchee River at Cashmere, Wash.	1,250	.....	.....	.....	.....	5.94	10.9	4.41	1.21	.74	.90	4.37	3.36	.....
Yakima River near Martin, Wash.	56	3.71	2.88	2.73	5.55	12.1	16.6	5.23	1.89	1.93	2.11	23.0	6.30	7.00
Yakima River at Clealum, Wash.	500	1.48	1.20	1.87	4.34	7.90	10.3	3.36	1.16	.96	.94	11.7	4.94	4.18
Yakima River at Umtanum, Wash.	1,540	.58	.61	.88	1.84	3.29	3.52	1.06	.58	.36	.38	4.47	2.48	1.67
Yakima River near Wapato, Wash.	3,300	.61	.56	.66	1.09	1.89	2.63	.63	.10	.04	.09	2.67	1.98	1.08
Yakima River at Kiona, Wash.	5,230	.60	.49	.58	.88	1.35	1.89	.46	.10	.05	.12	1.64	1.68	.82
Yakima River near Richland, Wash.	5,230	.....	.....	.....	.....	.....	.....	.....	.....	.03	.10	.....	.....	.....
Cabin Creek near Easton, Wash.	32	.....	.....	.....	.....	.....	8.50	1.47	.39	.27	.63	5.94	4.12	.....
Kachess River near Easton, Wash.	63	1.97	1.83	2.24	4.56	9.51	11.6	3.14	.67	.81	1.17	15.9	5.78	4.93
Clealum River near Roslyn, Wash.	205	1.19	1.07	1.67	4.65	9.90	13.1	4.51	1.37	1.31	1.25	14.7	4.93	4.97
Teanaway River near Clealum, Wash.	214	.....	.....	.....	3.02	4.00	2.56	.45	.04	.04	.19	4.04	1.43	.....
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Naches River at Anderson's ranch, near Nile, Wash.	391	.....	.....	.....	.....	5.22	7.37	2.69	.82	.54	.48	.....	.....	.....
Naches River at Oak Flat, near Nile, Wash.	636	.91	.75	.94	1.97	3.52	5.53	2.20	.58	.36	.36	4.12	2.59	1.98
Naches River below Tieton River, near Naches, Wash.	930	.....	.....	.....	2.10	3.85	6.28	2.22	.75	.51	.44	4.97	2.77	.....
Naches River at North Yakima, Wash.	1,120	.79	.49	.71	1.46	2.82	4.41	1.38	.22	.13	.25	4.28	2.11	1.59
Bumping River at Bumping Lake, near Nile, Wash.	68	.....	.....	.....	.....	8.54	16.0	6.00	1.50	.94	.92	10.6	5.74	.....
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Tieton River at Cobb's ranch, near Naches, Wash.	289	.....	.....	.....	.....	3.56	5.39	2.35	1.33	.99	.72	5.47	2.24	.....
North Fork of Atanum Creek near Tampico, Wash.	66	.....	.....	.....	.....	.....	3.18	1.05	.44	.32	.26	1.25	1.50	.....
Atanum Creek at The Narrows, near Tampico, Wash.	116	.36	.36	.88	1.08	1.58	1.87	.53	.22	.20	.21	1.10	1.11	.79
South Fork of Atanum Creek near Tampico, Wash.	28	.30	.37	1.01	1.08	1.45	1.88	.30	.18	.15	.16	1.01	1.07	.75
Toppenish Creek near Fort Simcoe, Wash.	135	.....	.....	1.44	2.09	1.95	.47	.16	.10	.16	.16	1.47	1.46	.....
Toppenish Creek near Wapato, Wash.	416	.....	.....	.....	.80	.60	.....	.....	.07	.06	.....	.....	.....	.....

Summary of mean discharge, in second-feet per square mile, in north Pacific coast drainage basins, for 1909—Continued.

Gaging station.	Drainage area (square miles).	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Toppenish Creek at Alfalfa, Wash	520	.....	.....	.....	.88	.74	.55	.31	.29	.18	.24	.58	.87	.....
Simcoe Creek near Fort Simcoe, Wash	80	.....	.....	.77	.79	.74	.16	.02	(a)	(a)	.01	.27	.45	.....
Satas Creek near Toppenish, Wash	246	.56	.70	.68	.69	.63	.45	.15	.09	.07	.12	.59	.90	.47
South Fork of Snake River at Moran, Wyo	820	.92	.95	.83	.74	1.63	9.95	4.27	6.06	1.68	1.32	1.24	1.34	2.58
South Fork of Snake River near Lyon, Idaho	5,480	.53	.56	.53	.77	2.59	6.99	3.96	2.17	1.15	.81	.83	.75	1.80
Snake River near Minidoka, Idaho	17,900	.40	.38	.36	.40	.88	1.83	1.09	.43	.52	.40	.46	.48	.64
North Fork of Snake River near Ora, Idaho	1,040	1.10	1.11	1.03	1.42	3.02	2.60	....	....	....	....	....	....	.....
Fall River at Fremont, Idaho	390	.....	.....	.99	1.70	4.54	8.64	....	....	....	....	....	....	.....
Teton River near St. Anthony, Idaho	960	.62	.51	.40	.82	1.81	5.03	....	....	....	....	....	....	.....
Blackfoot River near Presto, Idaho	1,020	.24	.26	.22	.65	1.67	1.04	.36	.22	.28	.33	.34	.49	.51
Big Wood River near Shoshone, Idaho	1,780	.13	.08	.10	1.13	.83	1.12	.34	.01	.05	.06	.12	.10	.34
Owyhee River at Owyhee, Oreg[b]	11,100	.43	.15	.28	.44	.26	.12	.02	(a)	.01	.01	.04	.07	.15
Boise River near Highland, Idaho[b]	2,650	.84	.75	1.42	2.98	3.68	4.11	1.38	.39	.36	.38	1.26	.76	1.52
Malheur River at Vale, Oreg	4,190	.42	.22	.22	.23	.09	.08	.01	.01	.03	.02	.04	.04	.12
Middle Fork of Malheur River above South Fork, near Riverside, Oreg	1,110	.53	.25	.31	.48	.20	.14	.08	(a)	.09	.14	.11	.05	.20
North Fork of Malheur River near Beulah, Oreg	436	.....	.....	.....	.51	.42	.38	.11	.08	.13	.13	.19	.14	.....
Payette River near Horseshoe Bend, Idaho	2,240	1.03	.82	1.04	2.64	4.69	6.79	2.36	.77	.62	.63	1.62	.98	2.00
Powder River at Salisbury, Oreg	230	.34	.27	.64	.87	1.31	1.39	.16	.03	.01	.08	.48	.17	.48
Powder River near North Powder, Oreg	826	.....	.....	.....	.28	.13	.66	.06	.02	.03	.04	.12	.24	.....
Grande Ronde at Hilgard, Oreg	660	.22	.23	.70	1.18	1.12	.70	.08	.02	.10	.08	.22	.39	.42
Grande Ronde at Elgin, Oreg	1,350	.26	.24	.59	.99	1.13	.98	.13	.05	.05	.06	.23	.22	.41
Wallowa River near Joseph, Oreg	47	.98	.92	.85	1.42	2.55	11.7	9.06	7.72	3.21	1.89	1.88	2.23	3.70
Wallowa River near Elgin, Oreg	870	1.28	.77	1.07	1.39	2.45	4.64	2.14	.76	.61	.60	1.10	.87	1.47
Palouse River at Hooper, Wash	2,210	1.14	.54	.44	.26	.15	.05	.02	.01	.01	.01	.08	.16	.24
Umatilla River at Gibbon, Oreg	353	1.67	1.41	2.45	2.97	2.27	.80	.24	.16	.15	.19	1.84	1.37	1.29
Umatilla River near Yoakum, Oreg	1,200	.82	.59	1.02	1.06	.74	.24	.05	.03	.03	.05	.55	.68	.49
Umatilla River near Umatilla, Oreg	2,130	.47	.26	.40	.39	.24	.06	(a)	(a)	(a)	.03	.26	.34	.20
John Day River near Dayville, Oreg	1,000	.34	.33	.42	.51	.50	.57	.14	.05	.07	.10	.22	.20	.29
John Day River at McDonald, Oreg	7,800	.20	.17	.31	.43	.42	.34	.06	.02	.02	.03	.14	.16	.19
South Fork of John Day River at Dayville, Oreg	600	.25	.27	.45	.59	.31	.13	.04	.01	.04	.03	.20	.12	.20
Deschutes River at Allen's ranch near Lava, Oreg	720	.21	.28	.28	.49	.64	.68	.37	.22	.20	.18	.77	1.04	.45
Deschutes River at West's ranch near Lava, Oreg	1,240	1.33	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Deschutes River at Benham Falls, Oreg	1,480	1.11	1.07	.98	1.16	1.21	1.21	1.08	1.03	1.03	1.00	1.38	1.30	1.13
Deschutes River at Bend, Oreg	1,530	1.02	1.01	.94	.99	.95	.93	.88	.71	.77	.81	1.35	1.38	.98
Deschutes River at Laidlow, Oreg	1,880	.80	.81	.76	.79	.76	.79	.66	.53	.58	.65	1.35	1.20	.81

[a] Value less than 0.01 second-foot per square mile.
[b] The drainage area for this station has been revised on the basis of later map measurements.

Summary of mean discharge, in second-feet per square mile, in north Pacific coast drainage basins, for 1909—Continued.

Gaging station.	Drainage area (square miles).	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Deschutes River near Biggs, Oreg.	9,180	.82	.79	.83	.93	.78	.74	.61	.58	.59	.61	1.03	.96	.77
West Fork of Deschutes River near Lava, Oreg.	500	.....	.....	.....	.....	1.97	2.08	2.00	2.00	1.99	1.93	2.26	2.32	.....
Squaw Creek near Sisters, Oreg.	90	.....	.....	.....	.....	1.24	2.16	1.69	1.29	.90	.67	.....	.....	.....
Crooked River near Post, Oreg.	1,390	.22	.27	.53	.68	.21	.04	.02	.01	.02	.03	.34	.29	.22
Crooked River near Prineville, Oreg.	1,990	.10	.21	.38	.57	.14	.04	.02	.01	.02	.03	.22	.12	.15
Ochoco Creek near Prineville, Oreg.	300	.33	.37	.46	.59	.32	.11	.02	(a)	(a)	(a)	.34	.51	.26
Metolius River near Sisters, Oreg.	400	4.18	4.15	4.08	4.05	4.15	4.35	4.02	3.78	3.60	3.52	4.90	4.42	4.1
Klickitat River at Klickitat, Wash.	1,090	.....	.....	.....	.....	.....	.....	.....	.94	.78	.71	2.53	2.20	.....
Bull Run near Bullrun, Oreg.	96	15.5	10.2	7.70	8.50	9.23	4.93	3.03	1.28	1.23	2.90	32.1	8.72	8.78
Middle Fork of Willamette River at Jasper, Oreg.	1,450	9.93	5.05	3.29	1.99	2.05	2.09	1.10	.82	.81	.86	9.03	4.05	3.42
Willamette River at Albany, Oreg.	4,860	9.67	5.91	3.83	2.03	1.81	1.76	1.03	.70	.61	.76	7.10	5.16	3.36
Coast Fork of Willamette River near Goshen, Oreg.	690	10.6	5.97	3.14	.99	.78	.60	.34	.12	.09	.31	6.99	5.04	2.91
McKenzie River near Springfield, Oreg.	960	10.0	7.03	5.62	4.38	4.74	4.34	2.94	2.48	2.16	2.34	10.6	8.33	5.41
Luckiamute River near Suver, Oreg.	233	12.3	13.7	5.24	1.95	1.21	1.06	.58	.31	.26	.54	15.8	10.7	5.30
South Fork of Yamhill River at Sheridan, Oreg.	290	16.0	19.7	5.17	1.15	.59	.51	.....	.....	.....	.....	.....	.....	.....
Clackamas River near Cazadero, Oreg.	685	9.27	5.47	4.42	4.66	4.91	3.84	2.00	1.49	1.41	1.59	12.7	5.81	4.80
Clackamas River at Estacada, Oreg.	688	8.79	5.67	4.46	4.68	4.93	3.82	2.02	1.63	1.54	1.79	12.4	6.06	4.82
Lewis River above Muddy River, near Cougar, Wash.	250	.....	.....	.....	.....	.....	.....	.....	1.52	.90	1.06	.....	.....	.....
Lewis River at Peterson's ranch, near Cougar, Wash.	474	.....	.....	.....	.....	.....	.....	.....	1.70	1.28	1.50	.....	.....	.....
Lewis River at Ariel, Wash.	728	.....	.....	.....	.....	.....	.....	.....	1.52	1.92	2.07	.....	.....	.....
Muddy River at mouth, near Cougar, Wash.	121	.....	.....	.....	.....	.....	.....	.....	2.26	1.50	1.95	.....	.....	.....
Pine Creek at mouth, near Cougar, Wash.	21	.....	.....	.....	.....	.....	.....	.....	6.67	6.67	6.71	.....	.....	.....
Swift Creek at mouth, near Cougar, Wash.	26	.....	.....	.....	.....	.....	.....	.....	6.65	6.42	6.61	.....	.....	.....
Cedar River, near Ravensdale, Wash.	170	5.24	4.21	3.61	4.11	5.65	6.00	2.55	1.86	1.82	1.76	12.2	6.65	4.64
Skagit River, near Marblemount, Wash.	1,090	1.84	1.47	1.61	2.84	7.23	13.9	8.15	3.82	2.65	1.99	7.91	4.26	4.81
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a Value less than 0.01 second-foot per square mile.

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